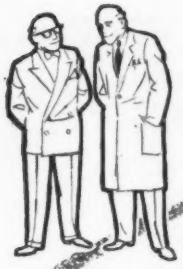
MACHINERY



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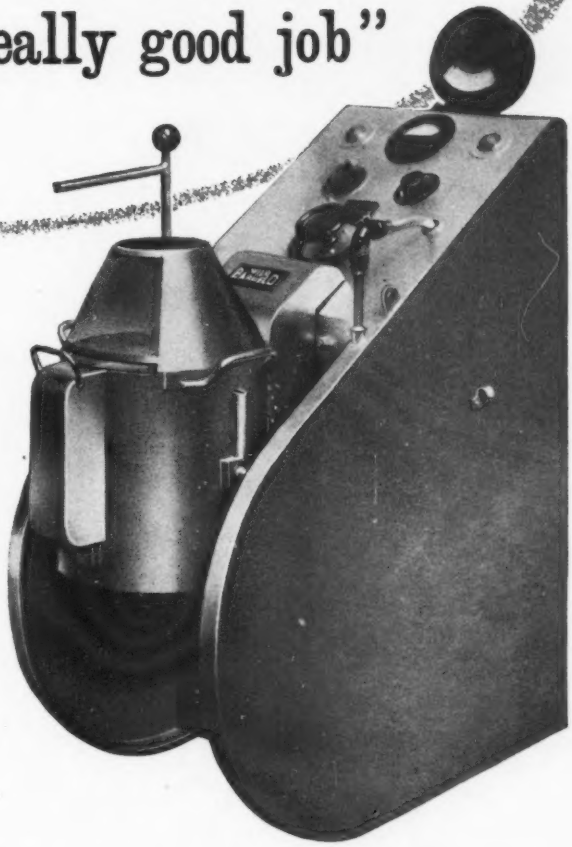
Where heat-treatment is concerned—are you doing the job as economically as possible? It's surprising the number of people who invest in expensive machine tools for production—and then spoil a good job in outdated furnaces. And the result? Rejects—time, money and probably customer goodwill lost. More and more people are relying on Wild-Barfield equipment. Write for full details and see how you can save by changing to modern electric furnaces.

Self-contained Electrode Salt Bath ESB 346.



ELECTRIC WILD BARFIELD FURNACES

FOR ALL HEAT-TREATMENT PURPOSES

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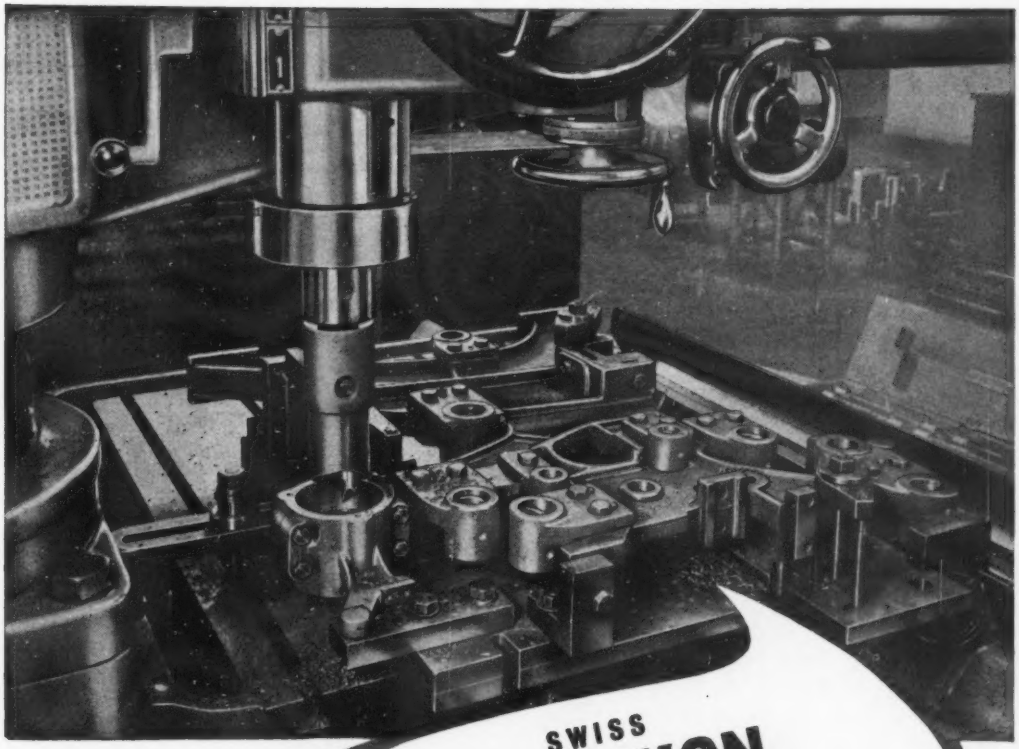

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Double columns for extra rigidity.
Electro-magnetic quill clamping with finger-tip control. 18 spindle speeds, 15 feeds. 2-speed quick traverse.

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58⅝", 66" or 89⅛" between columns.
Table traverses 42½" or 47¼".

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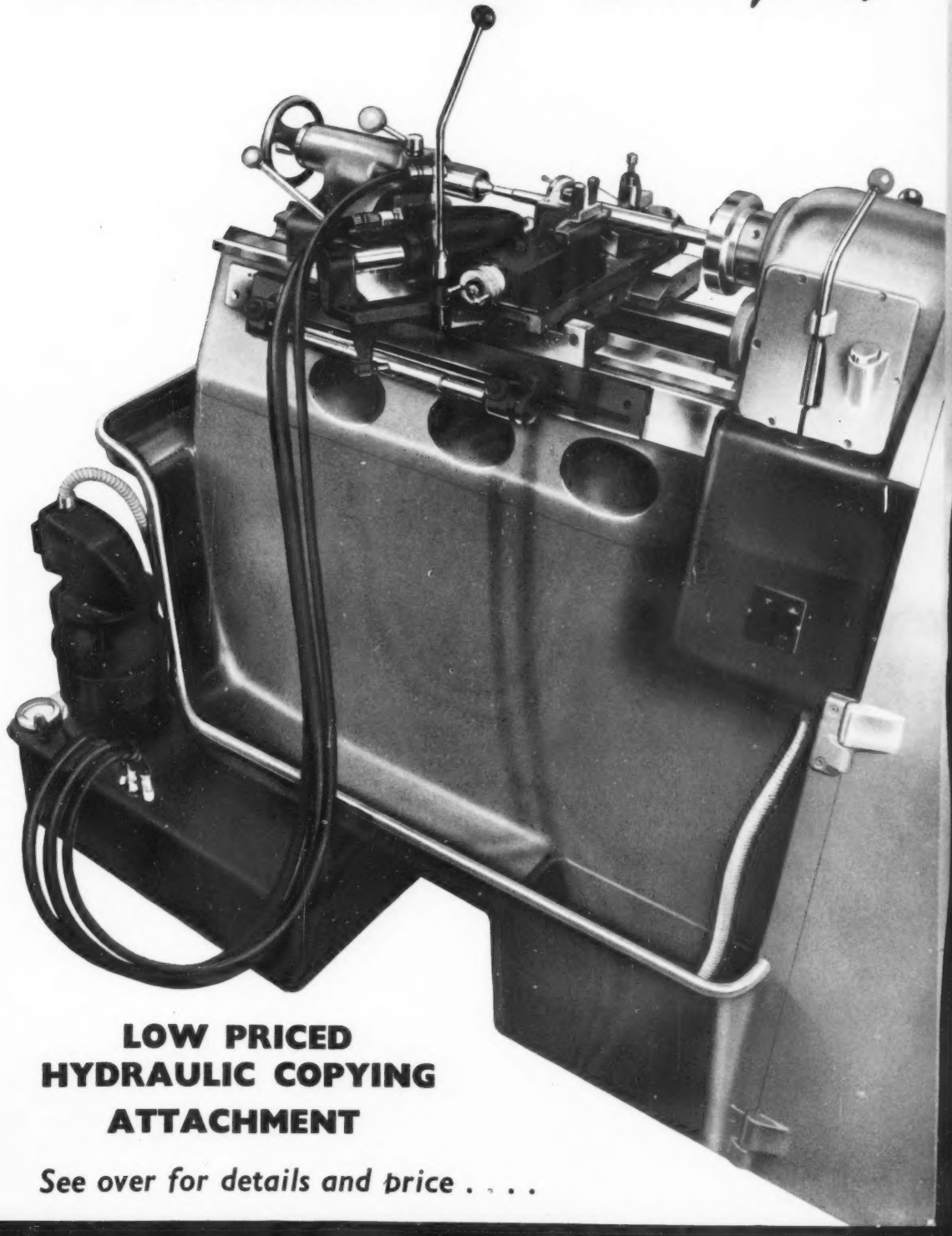

LOW PRICED HYDRAULIC COPYING ATTACHMENT

See over for details and price . . . .

★ **LOW PRICE COUPLED WITH GREAT ACCURACY**
★ **CONSISTS OF THREE BASIC FULLY INTERCHANGEABLE ASSEMBLIES**
★ **IDEAL FOR MACHINING SLOW TAPERS ETC.**
★ **DEPTH OF CUT CONTROLLED FROM OPERATING POSITION**
★ **DOES NOT IMPEDE USE OF MACHINE AS NORMAL LATHE**

This new hydraulic copying attachment is the most reasonably priced attachment yet offered, and is available to users of COLCHESTER CHIPMASTER lathes.

Mounted directly on to the rear of the cross slide, the unit incorporates a potentiometric rather than the more conventional zero-lap type of hydraulic tracer valve. This avoids many of the troubles associated with zero-lap valves. Slow tapers can be turned accurately and with confidence. The unit can also be used for taper turning, boring and facing on chucked components, taper threading, and threading of components up to a shoulder without the necessity of an undercut.

Three assemblies are linked to form the complete unit; the piston and cylinder assembly, the rear beam assembly and the free standing pump unit.

The piston and cylinder assembly is complete with the tracer valve unit and a mechanical retraction lever. The copying topslide carries a depth of cut adjusting handwheel which enables the depth of cut to be controlled from the normal operating position. Mounted at 60 deg. to the longitudinal axis of the bed, the copying slide can be retracted to such an extent that the attachment in no way impedes the normal use of the machine.

A specially ground and tapped pad is provided on the rear of the bed to accommodate the rear beam assembly consisting of a specially sectioned bar and two tailstock assemblies which carry the circular master between centres: this allows standard parallel masters to be used for taper turning.

The free standing pump unit has a pressure gauge mounted on the top in front of the vertical flange mounted pump motor. Motor switchgear is mounted on top of the motor, and connection between the pump unit and the piston unit is by three standard flexible hoses.

SPECIFICATIONS

PROFILER		CHIPMASTER LATHE	
Max. copying dia.	6in.	Height of centres	5⅜in.
Max. copying length	20in.	Distance between centres	20in.
Max. depth of profile in one setting	3in.	Swing over bed	10¼in.
Max. Front angle	5° undercut	Swing over cross slide	7in.
Max. Back angle	40°	Spindle speeds infinitely variable	35-3,000 r.p.m.
H.P. Hydraulic pump motor	½	H.P. motor	1½

CHIPMASTER lathe complete with Hydraulic Profiling Attachment

£518 nett ex works

THE COLCHESTER LATHE COMPANY LIMITED

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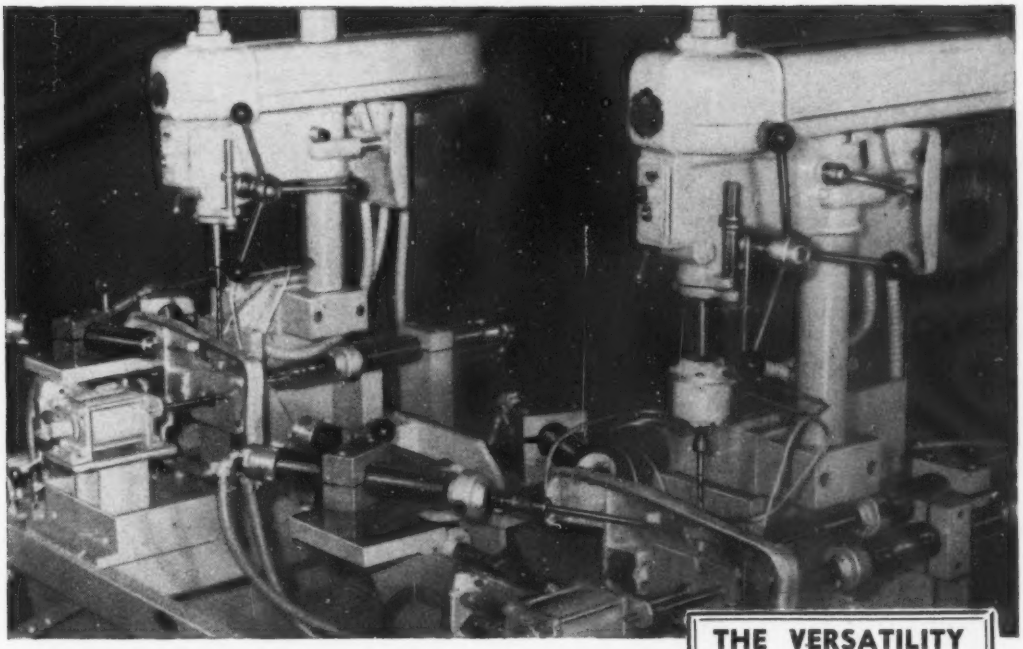

Par-A-Matic set-up for reaming and tapping an out-board motor tiller casting.

"ARO-BROOMWADE" PAR-A-MATICS

Save Man-Hours

Par-A-Matics are compact, self-feed pneumatic tools designed for multiple drilling, burring, tapping, grinding, reaming, nut-running, positioning . . . almost any operation requiring rotating tools which can be accommodated in a $\frac{1}{4}$" or $\frac{5}{16}$" chuck.

QUICKLY ADAPTED TO CHANGING NEEDS.

Par-A-Matics are invaluable for long or short production runs. Gears are interchangeable for speedy conversion to any of seven speeds from 500 to 17,000 R.P.M. You can easily mount Par-A-Matics at any angle for automatic or semi-automatic operation. You can link any number for simultaneous functioning. One man, using a remote control valve, can operate a whole battery of Par-A-Matics.

Par-A-Matics really *will* SAVE YOU MONEY. Ask for Publication No. 443 T.E. Expert technical advisers are available for guidance on schematic layouts, based on a wide experience in the application of Par-A-Matics.

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Air Compressors & Pneumatic Tools

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THE VERSATILITY OF PAR-A-MATICS covers almost any kind of rotating tool

605 SAS

The Cocktail Bar at the Lygon Arms Hotel, Broadway, Worcs. This old-established posting house on A44 (Moreton in Marsh—Evesham Main Road) has, throughout its long history, kept fully abreast of the times, and is as well known to-day for comfort, modern amenities and courteous, efficient service as ever it was in the heyday of the Coaching Era. Illustrations by courtesy of Lygon Arms Ltd.

The vogue in Cocktail Bars may change from time to time, but there is no passing vogue in Coghlan Precision Bright Bars. For fifty years they have maintained a consistently high quality which has never failed to meet the most exacting demands of ever improving techniques in every sphere of engineering production.

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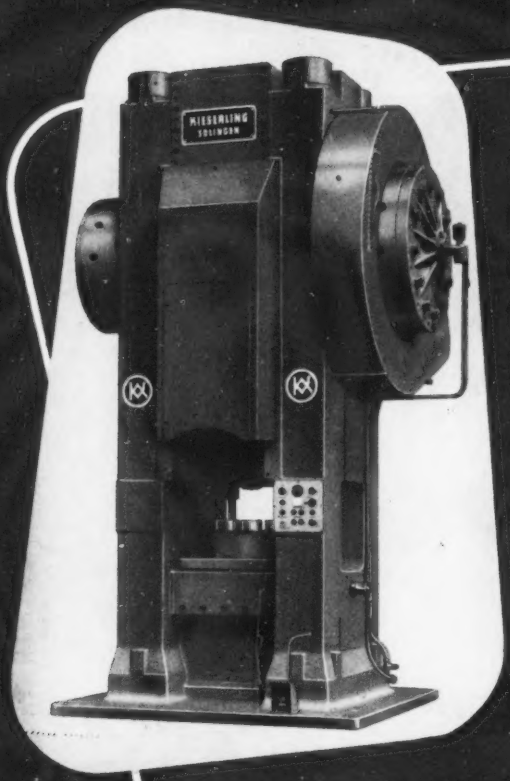

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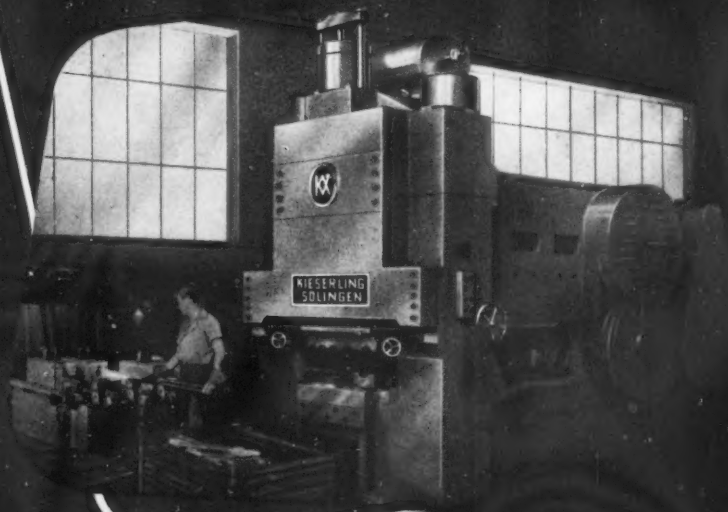

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COVENTRY GAUGE & TOOL COMPANY LTD

OPTICAL TWIST DRILL COMPARATORS

The Comparator provides a quick and simple means of checking twist drill points for centrality and correctness of angle by comparing the projected image of the drill point against a graticule. Three models available (a) Range .013″ to 3/64″ (b) 3/64″ to 1/8″ (c) 1/16″ to 1/4″.

DRILL POINT MEASURING INSTRUMENT

An Instrument for checking the larger range of drill. Two separate vee-ways are employed to align the drill, with anvils movable under the action of the drill point, and errors of angle or centrality are indicated on a common dial gauge. Setting piece supplied with each instrument. Two models available (a) Range 1/4″ to 3/4″ (b) 3/4″ to 2.1/2″.

Coventry Gauge

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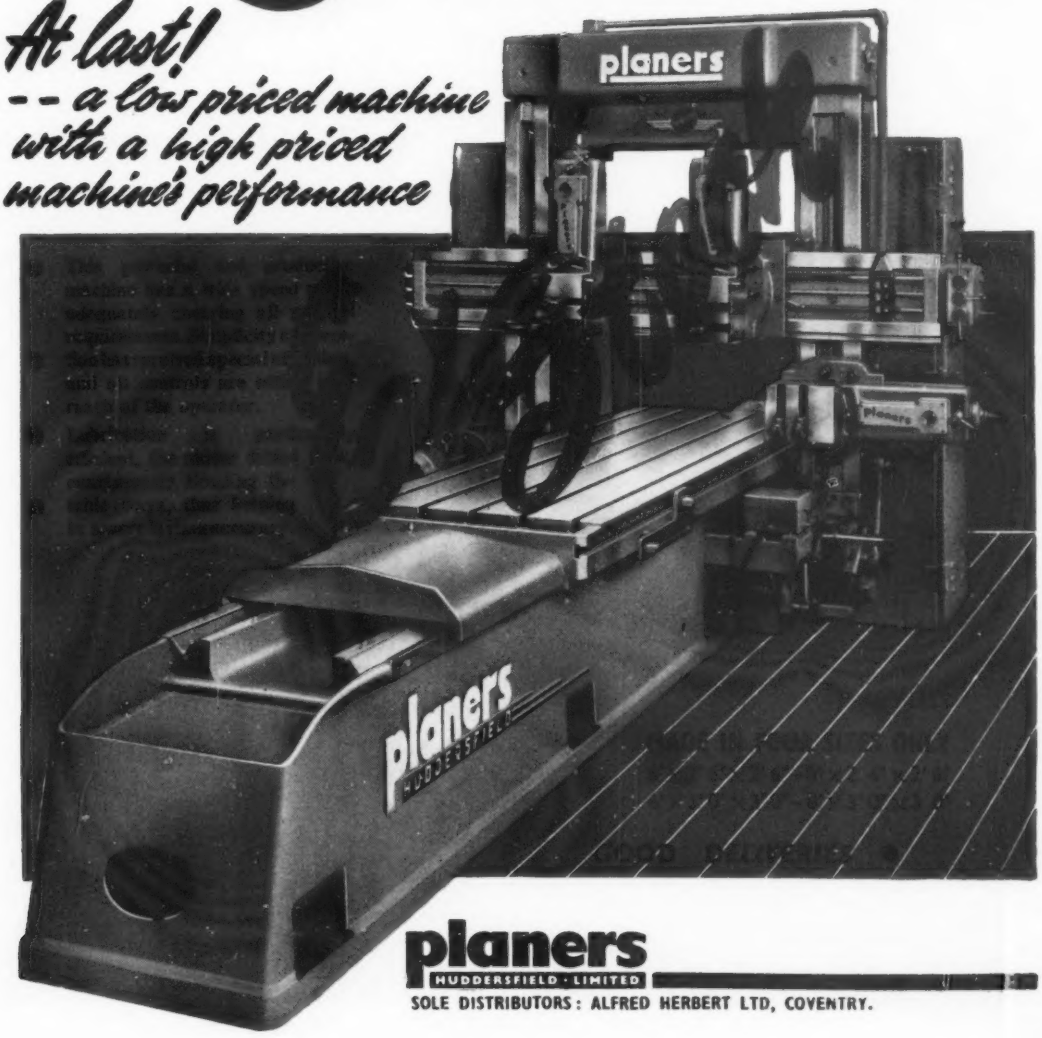
WORM REDUCTION DRIVE PLANING MACHINE

At last!
-- a low priced machine with a high priced machine's performance



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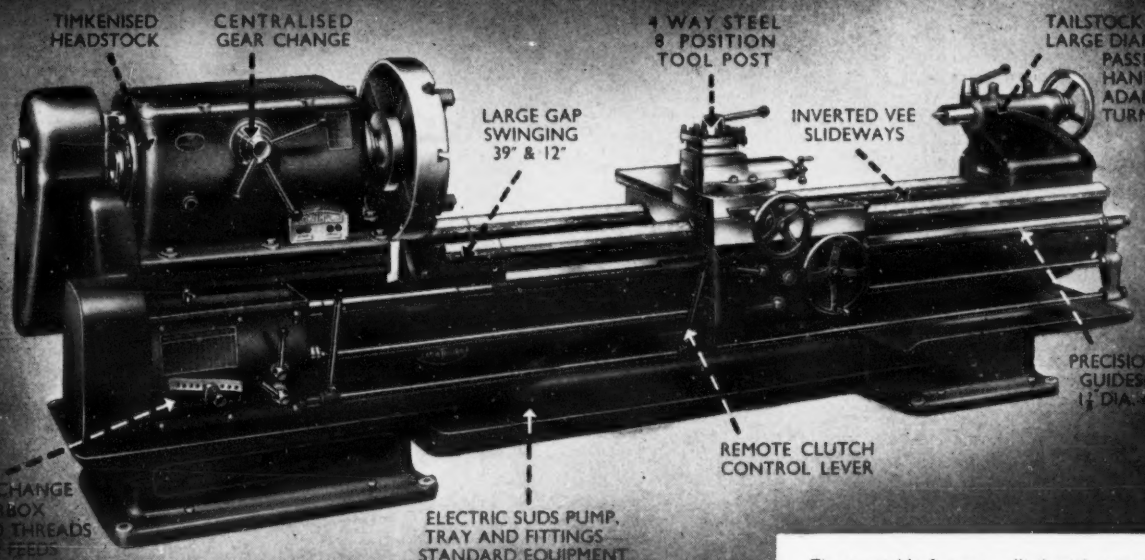
12½" heavy duty CENTRE LATHE



These notable features, allied with superior quality in every stage of design and manufacture have made Crowthorn lathes famous for high speed precision work under exacting conditions.
Reasonable delivery times.
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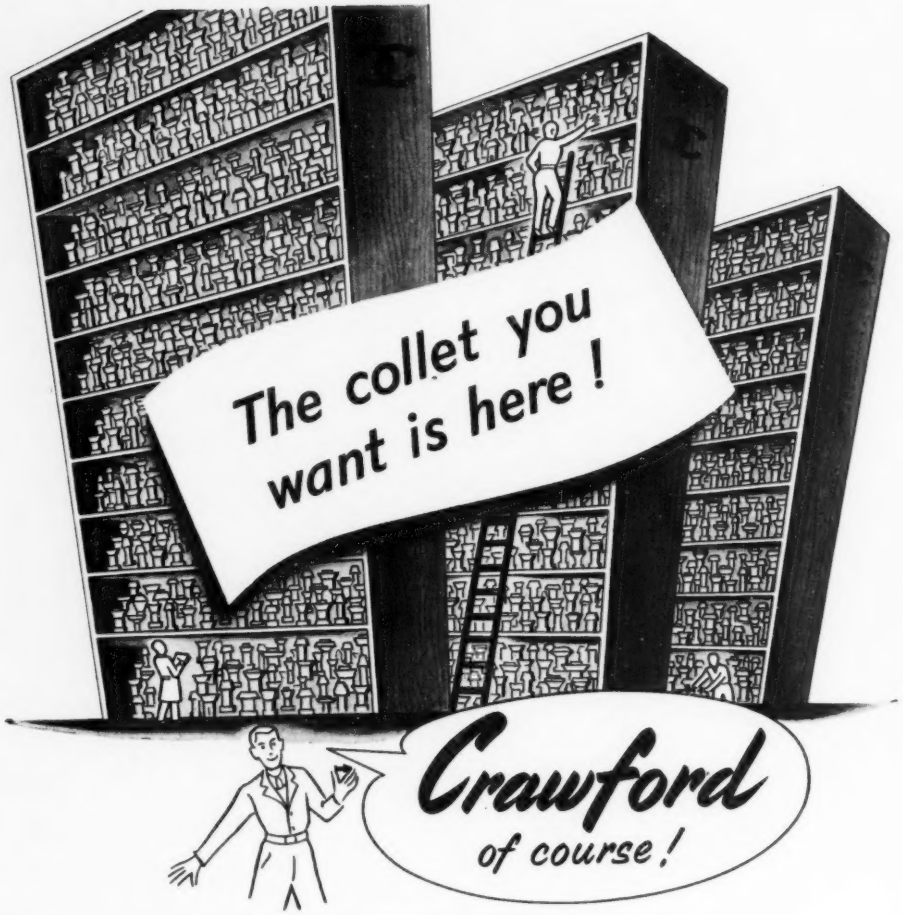

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. . . for precision lathes, watchmakers lathes, milling machines, drilling machines, etc. Crawfords, specialists in collets for more than sixty years, can supply collets of every size and shape, all standard types being held in stock—and specials can always be made to your specifications. Write now for further details.

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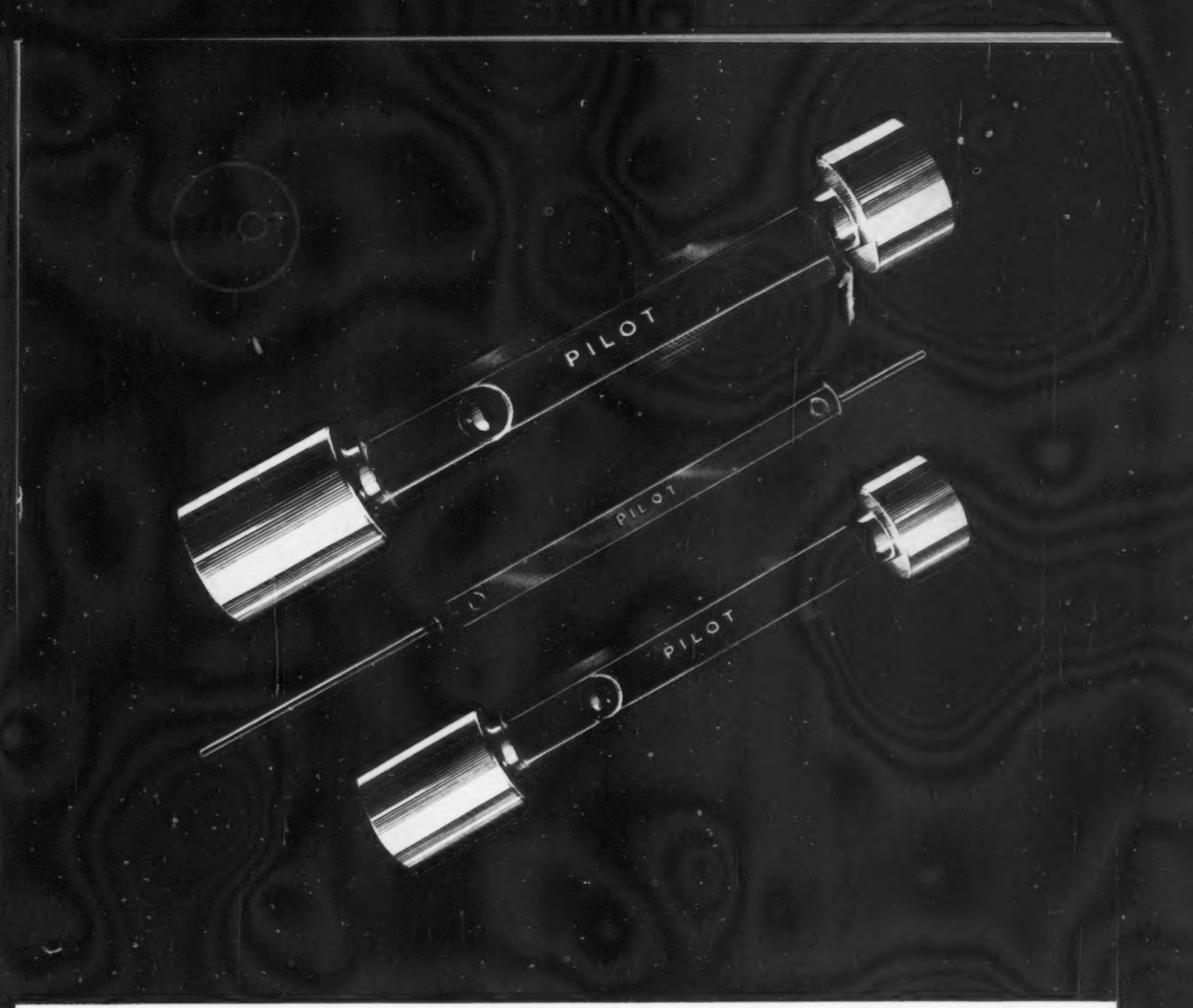

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3" optical rotary and inclinable table

Extending the range of O.M.T. Optical Rotary Indexing Tables, this new 3" inclinable model simplifies machining or inspection of workpieces with compound angles.

For the rotary movement scale reading by an easy-to-read, 100-unit illuminated projection system is stated to 5 seconds of arc and a design feature permits the table to be set to give a zero reading in any position. The circular position in the inclined plane is observed through a microscope.

ABRIDGED SPECIFICATION

Diameter of plates	3" (76.2 mm)
Height (horizontal position)	2" (50.8 mm)
Height (vertical position)	12½" (317.5 mm)
Overall size	22" x 12½" (559 mm x 317.5 mm)
Scale readings (rotary movement)	direct to 5 secs. of arc.
Scale readings (inclinable movement)	direct to 30 secs. of arc.

OTHER MODELS IN THE OMI RANGE

8", 10" and 12" Rotary Tables: the new models also available with automatic positioning systems if required.

12" and 20" Rotary and Inclinable Tables with scales for both movements reading direct to 1 second of arc.

ONE OF THE NEWALL GROUP

A precision product of

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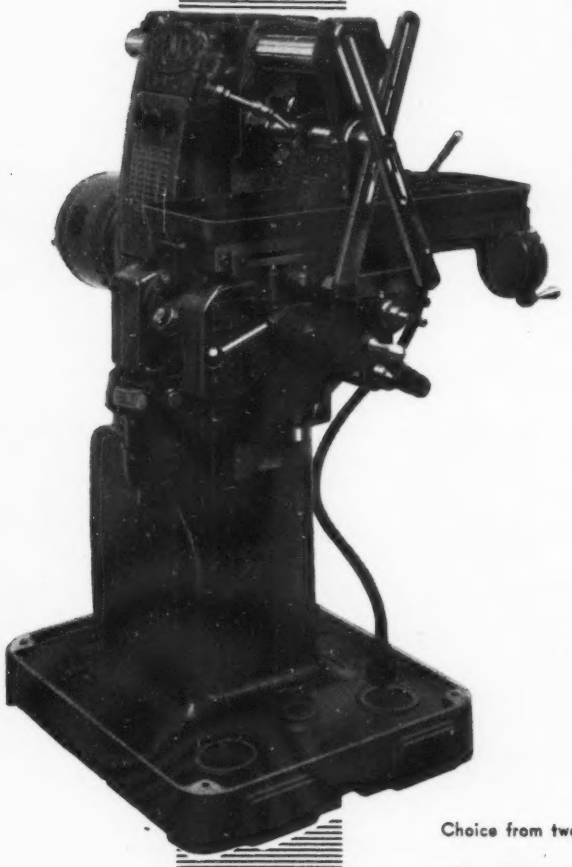
UNIQUE for a milling machine of its size the

EDGWICK Nº1 SIMPLIMIL

fitted with an all-geared drive assembly featuring:—



★ *Nickel - Chrome heat - treated spindle with flywheel*

★ *Precision spindle bearings—locked inner and outer races*

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★ *Double - wall construction*

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Automatic Feed 10" x 3¾" x 13"

Choice from two ranges of six speeds 60-540 r.p.m. or 224-2020 r.p.m.

Alternative range of feeds on Automatic machine — five feeds from ½" to 3" per min., or three feeds, 3⅞", 6" and 9⅝" per min.

Available for Immediate Delivery

AD.403

ALFRED HERBERT LTD., COVENTRY
Factored Division, Red Lane Works.

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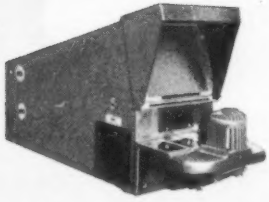

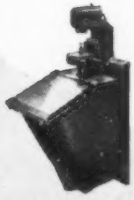

measurement by projection with

HILGER

Inspection Enlargers

Simple projectors for checking form and dimensions of small components against enlarged layouts. Thread forms can also be checked against templates.
Mag. from X 10 to X 500.

Production Projectors

Similar to Inspection Enlargers, but designed for use in the horizontal position so that the operator can be seated for rapid checking, without fatigue, of mass-produced components.

Universal Projectors

Combine the advantages of ordinary projection with the addition of micrometer measuring equipment reading to 0.0001in. Co-ordinate measurements to 0.0001in. and angular measurements to 1 minute can be made.

Largest instrument will accommodate work up to 50 lbs. in weight, projector screen being 20in. dia. and measuring range 7in. horizontally and 2½in. vertically.

Send for illustrated catalogue "Hilger projectors for production."

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RANGE OF
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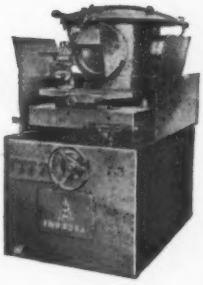
UNIVERSAL TOOL AND CUTTER GRINDER
Type M6 AR

These machines are precision made and an exceptionally comprehensive range of standard equipment is included in the very moderate price.
Special features are the ***Power Feed to Table*** and the equipment for ***Wet Grinding.***

BRIEF SPECIFICATION OF TYPE M6 AR.

Dia. of grinding wheels	8″
Working surface of table	32″ x 5″
Longitudinal movement of table	13¾″
Cross movement of table	7¾″
Min. height of grinding wheel over table	2″
Vertical movement of grinding wheel spindle	7″
Height of centres	5″
Max. distance between centres	20″
Motorised	400/3/50



ROTARY HEAD CARBIDE TOOL GRINDER
Type MO 14

Supplied with four grinding wheels mounted on rotary head, for roughing, sharpening, lapping and chip breaking in succession or for single operation of each wheel. Micro adjustment of tool holder, which accommodates all sizes and shapes of tools up to 2½″ sq. section.

CARBIDE TOOL GRINDER
Type MO 13

Fitted with two wheels, one for sharpening and one for lapping. The various faces of the tool can be ground in succession without removing tool.

CARBIDE TOOL GRINDER
Type MO 15

With only one operating post. Fitted with two diamond wheels, one for sharpening, the other for lapping. Tools can be ground all faces without removing.

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THE 600 GROUP OF COMPANIES

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Four-Way Tapping Machine

for cutting four threads simultaneously in zinc die castings for THE NORGREN SPRAY-LUBE SYSTEM

DESIGNED AND BUILT FROM STANDARD MACHINE PARTS BY **AMT**

If you have a similar production problem our Design Engineers are at your service.

" This machine was designed and built by A.M.T. (B'ham) Ltd., for simultaneous tapping of four holes in Zinc alloy regulator bodies. Machining is carried out by four BROOKE Unit Heads, and component clamping is effected by an air operated bridge clamp. Electrical and air control equipment is built into the base, with setting switches and buttons mounted on the compartment doors. A 6-spindle tapping Multi Head was supplied with the machine for attachment to the rear Unit Head for a subsequent operation, tapping six equally spaced holes on the component periphery. Floor to floor time per component is 11 seconds."

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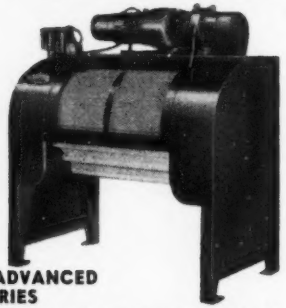
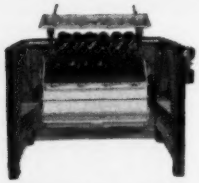
has the right barrel finishing equipment for you!



Model DB 200

ALMCO'S "ADVANCED DESIGN" SERIES

Thirteen great models in this series! These machines feature a wide range of variable speeds (infinite from 6 to 30 r.p.m.), making possible economical deburring and finishing of the greatest variety of parts. Each unit has Almco's exclusive design features and rugged construction to stand up under all types of punishing applications.

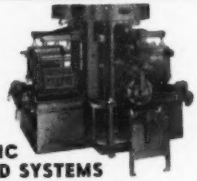


"FIXTURE" TYPE BARRELS

Pioneered by Almco for processing large and intricate parts. Custom designed fixtures hold parts securely, prevent part-on-part impingement and allow abrasive action to reach all surfaces, cavities, slots, etc. Barrels have automatic forward and reverse controls.

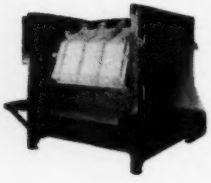
MULTI-COMPARTMENT BARRELS

Do you have these deburring and finishing problems—wide variety of parts or small quantity runs where fixtures would be too costly? Lack of floor space for several machines? An Almco custom-designed multi-compartment barrel may give you a cost-saving answer. Automatic forward and reverse. Any combination of compartments and doors.



SUB-O-MATIC AUTOMATED SYSTEMS

Almco's exclusive submerged unit is an automatic, "assembly line" system for micro-precision deburring and finishing of small parts in quantity. Saves labour, speeds up processing and flow of high production parts. One man can operate this equipment and handle as many as 192 barrel loads per 16 hr. day. Slashes compound expense to minimum. These submerged systems can also be obtained in non-automated, straight line systems.



CUSTOM-DESIGNED BARRELS

Almco designs and manufactures special barrels of all types for problems where standard equipment cannot be effectively used. These range from the smallest type to the largest fixture barrel such as the 60" diameter x 60" length barrel shown above. Special large diameter barrels with double flat or triple flat doors are also available to accommodate extra large parts and to allow abrasive media to flow freely over the outer periphery of the part. Your special problems may be solved with one of Almco's custom-designed barrels.

Model DB 01A

SMALLER MACHINES

Twin barrel machines manufactured by Almco are the standard of the industry for processing small lots of parts and for companies with large lots of small parts. Also ideal for sample processing, barrel finishing research and development work. These units are Almco engineered to the highest specification standards and include operational and safety features found on larger Almco machines.

YOUR SAMPLE PARTS PROCESSED without obligation in modern Almco test labs. Simply send parts direct to Hitchin, Herts. Enclose specifications desired. Complete free report includes recommendation.

Almco deburring and finishing machines are ruggedly constructed to perform on a round-the-clock basis. They incorporate the best engineering design required in the industry—your assurance of versatility and economical processing of work parts. Optional equipment includes material handling devices and systems, automatic forward and reverse, double or triple flat doors, single and dual timer controls for automatic delay starting and stopping, perforated drain doors for flushing and rinsing unloading devices, etc. Also a full and complete line of Almco Supersheen barrel finishing compounds and media of all types made especially for use with Almco precision barrel finishing equipment.

ALMCO Supersheen

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"ELB" LARGE WHEEL SURFACE GRINDING

is periphery grinding at its best. A large dia. wheel is used and fed across the work rapidly, spreading the cutting load over a wide area of the wheel, resulting in smooth and fast metal removal and low wear.

Non-compound table allowing a solid support in any position. Direct spindle drive avoiding loss of power. Special paraffin lubricated bearings running with the very minimum of play. Heavy cross-moving wheel head column assuring constant accuracy.

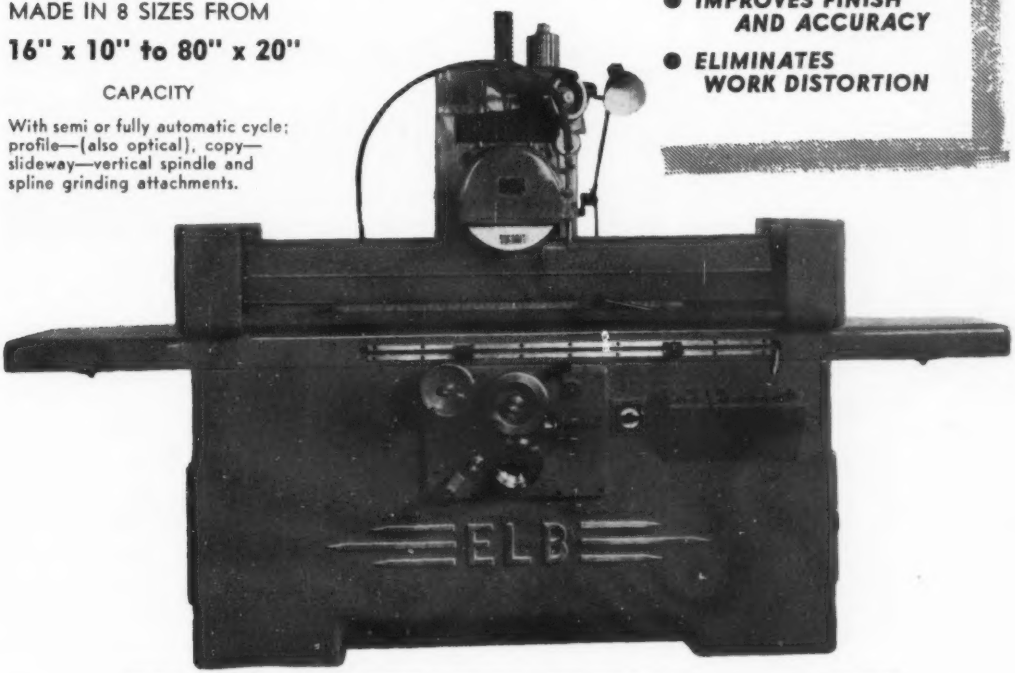
- **CUTS COSTS**
- **SPEEDS OUTPUT**
- **IMPROVES FINISH AND ACCURACY**
- **ELIMINATES WORK DISTORTION**

MADE IN 8 SIZES FROM

16" x 10" to 80" x 20"

CAPACITY

With semi or fully automatic cycle; profile—(also optical), copy—slideway—vertical spindle and spline grinding attachments.



You are cordially invited to a demonstration of new and reconditioned grinding machines at Soag's Battersea Showrooms

MONDAY, OCTOBER 13th, to FRIDAY, OCTOBER 17th

10 a.m. to 5 p.m. Bar and Buffet

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MOTOR COMPANY LIMITED

AUTOMATION

uses Tecalemit Lubrication

At the Standard Motor Company's Banner Lane factory in Coventry, the "Tecalemit-Bijur" Lubrication System is fitted to the three Archdale Multi-Station Transfer machines. These machines are used for machining the transmission housings for 100,000 Massey-Ferguson tractors each year.

Three "Tecalemit-Bijur" Lubricating Pumps are fitted to each machine, providing a measured quantity of oil for 170 lubrication points, at correct intervals, through calibrated metering valves. The "Tecalemit-Bijur" System, protects every bearing surface of the machine with a film of clean oil.

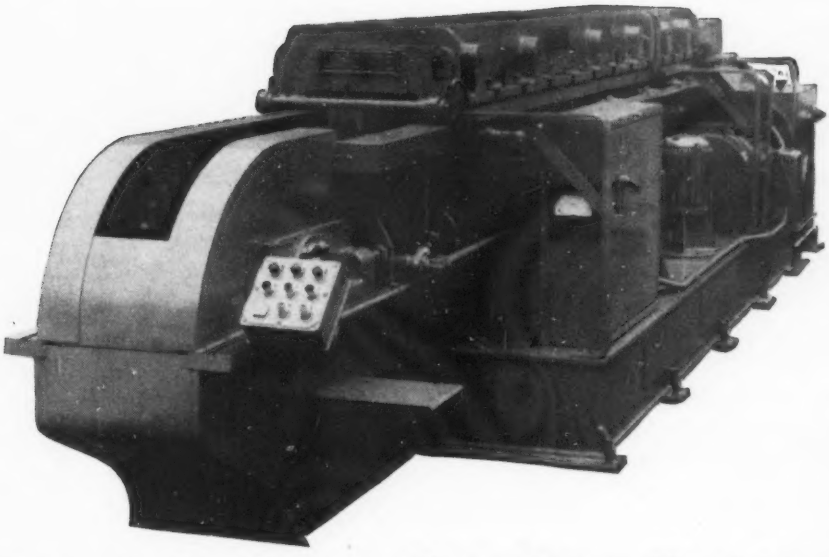
Tecalemit lubrication increases production time by doing away with oiling shut-downs, and by prolonging the life and precision of the machines. There's no oil wastage and maintenance costs are considerably cut.

T636A

TECALEMIT

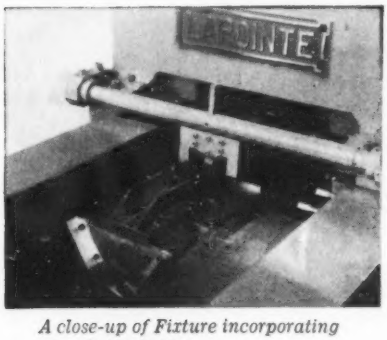
The Authority on Lubrication

TECALEMIT LIMITED
PLYMOUTH · DEVON



largest Continuous Broaching Machine

built in this country by



A close-up of Fixture incorporating acceptance gauge.

LAPOINTE

The 40/160" Continuous Broaching Machine is equipped with automatic clamping and unclamping Fixtures. In one operation this machine will broach the half bore, joint faces, locating width faces and backs of bolt bosses on Connecting Rods.

British Made

The Lapointe Machine Tool Co Ltd

Otterspool Watford-by-Pass Watford Herts
Telephone Gadebrook 3711 (4 lines) Cables Lapointe Watford
Also the Lapointe Machine Tool Company Hudson Mass. USA

6 TRANSVERSAL TOOLS AND
6 TOOLING POSITIONS ON THE TURRET

The multiple combinations available with this arrangement offer solutions to a considerable number of machining problems.
This is just one feature of the world famous
Petermann Automatic Screwing Lathes P.16 and P.25.
For illustrated literature giving details of all the features of these and other Petermann machines please write to :—

CHARLES CHURCHILL AND COMPANY LIMITED

COVENTRY ROAD, SOUTH YARDLEY, BIRMINGHAM 25. BRANCHES: LONDON, GLASGOW, NEWCASTLE, MANCHESTER

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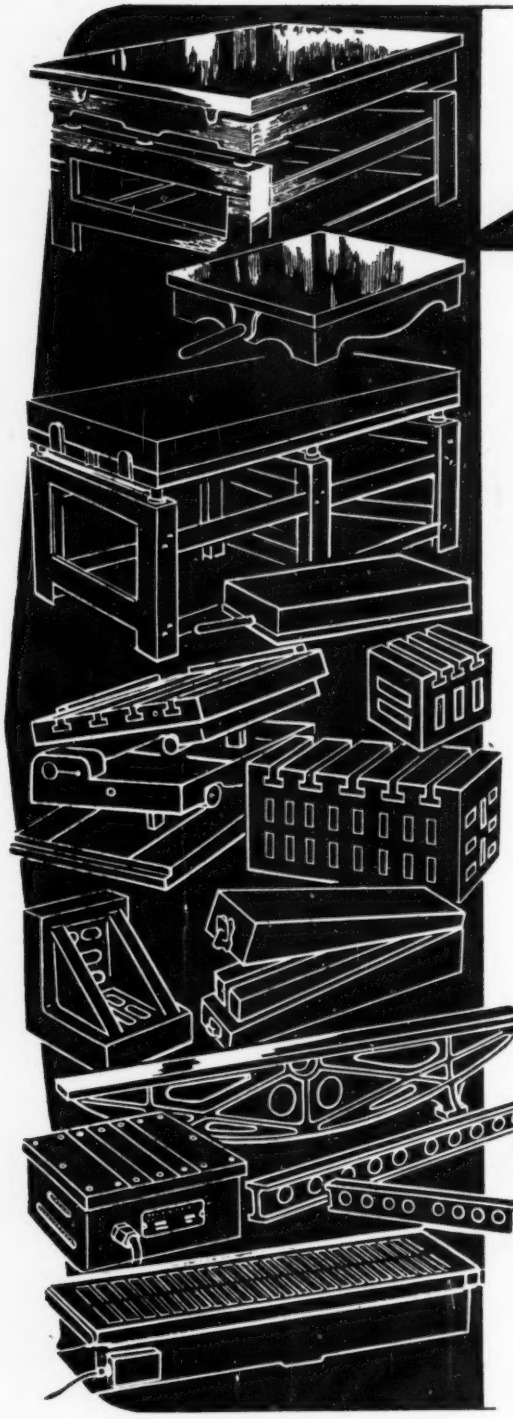

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SURFACE PLATES AND TABLES. Made from hard close-grained cast iron. Sizes from 6in. by 4in. up to 12ft. 0in. by 6ft. 0in. in Grade "A" and "B" accuracy.

GRANITE SURFACE PLATES AND TABLES. Made from hard close-grained black Swedish granite. Sizes from 8in. by 8in. up to 10ft. 0in. by 5ft. 0in.

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ANGLE PLATES AND BOX ANGLE PLATES. Made from hard close-grained cast iron and rigidly designed for stability. Grade "A" and "B" in all sizes.

STRAIGHT EDGES. Cast Iron Camel Back and "I" Section types from 12in. up to 16ft. 0in.

PARALLELS. Hardened Tool Steel to B.S.S. Grade "A" and "B". Complete in wooden case. Sizes 4in. up to 16in.

MAGNETIC CHUCKS. Made from high permeability steel castings and having exceptional holding power. Sizes from 12in. by 6in. up to 72in. long.

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LAPPING BLOCKS. Made from hard close-grained cast iron surfaced on top and bottom faces and grooved for lapping. Complete with cover for each face. Sizes 6in. by 4in. up to 12in. circular.

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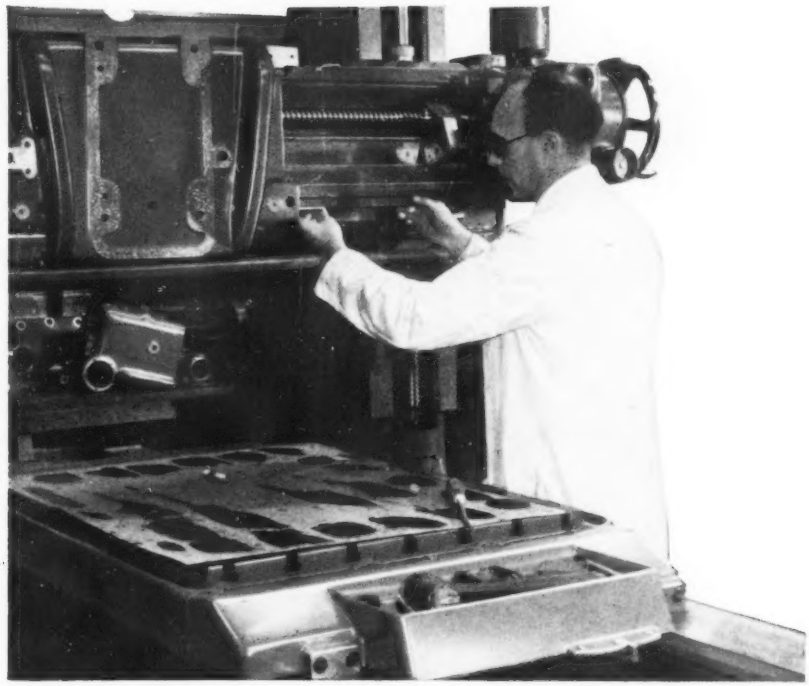

craftsmanship counts...

High precision machine tools repay care taken in the rebuilding and renewal of parts which have become worn. The jig boring and milling machines manufactured by Société Genevoise are serviced and renewed by the highly-skilled craftsmen of Sogenique (Service) Ltd.

The illustration shows Mr. H. Bond of the Assembly Department assembling the gib-strip on the spindle carriage of the Hydroptic-B jig boring machine, an operation requiring meticulous care in order to achieve perfect control of the settings of the spindle carriage. It is with such care and craftsmanship that the repair of Société Genevoise machine tools is carried out. Sogenique (Service) Ltd. also install and maintain these machine tools as well as train personnel in their operation.

Sogenique (Service) Ltd.

NEWPORT PAGNELL BUCKS. TELEPHONE NEWPORT PAGNELL 246

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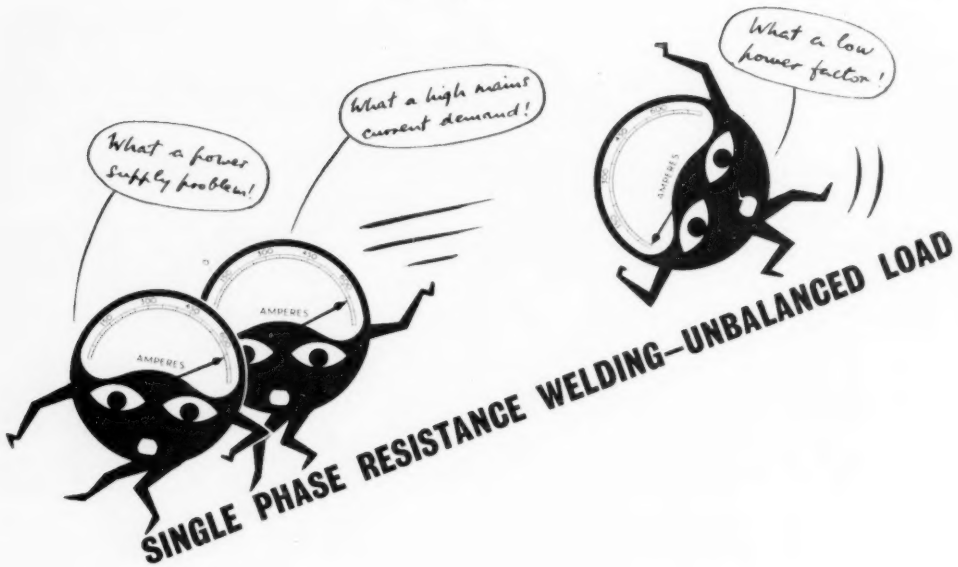
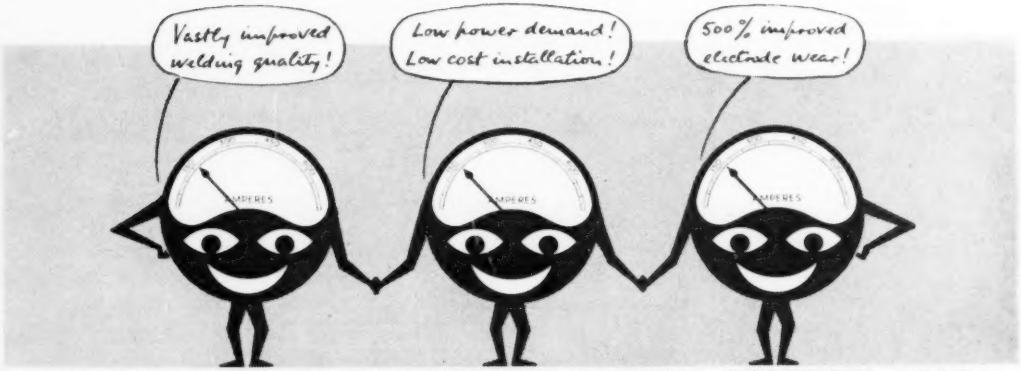
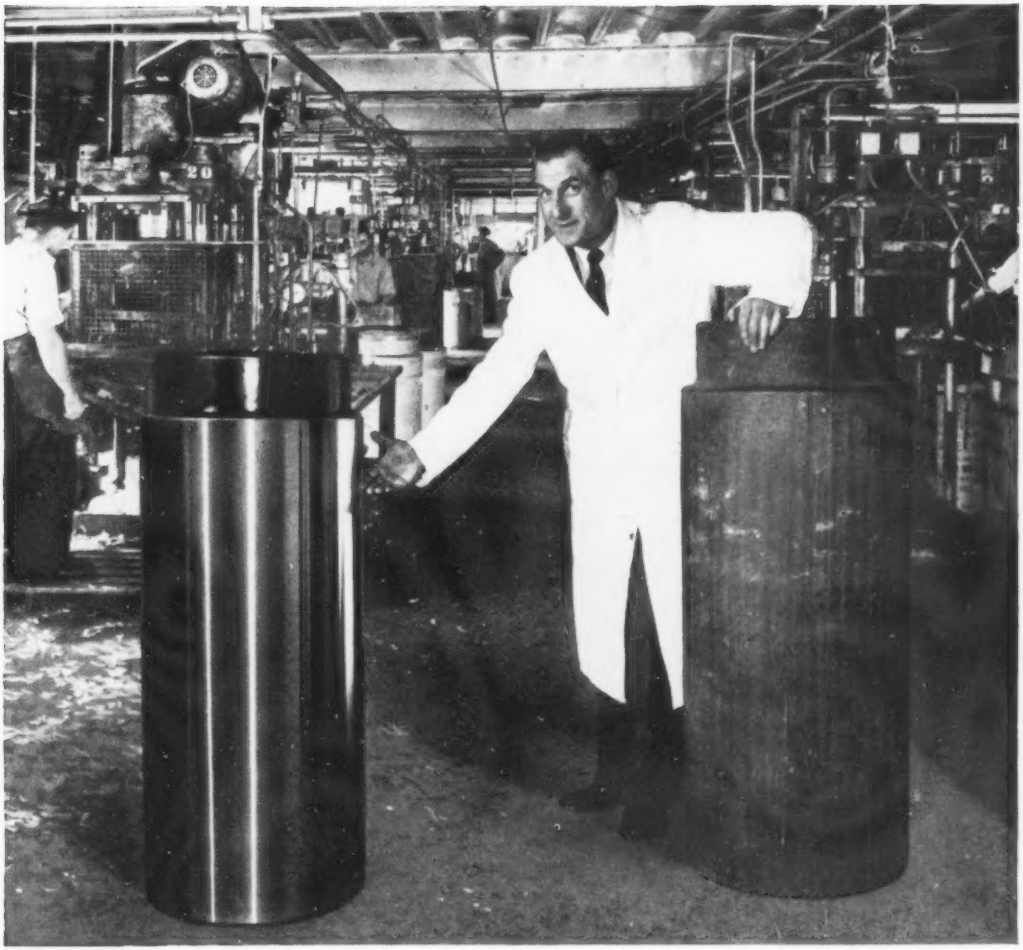


SINGLE PHASE RESISTANCE WELDING—UNBALANCED LOAD



SCIAKY PATENTED THREE PHASE WELDING—BALANCED LOAD

SCIAKY



See what Fescol can do

Here's the perfect before and after story of the Fescol process. The ram on my left is untreated, and has become corroded and pitted by wear and corrosion, in this condition it has reached the end of its useful life. Now look at the other ram, it was just the same before it was 'Fescol'-ised and now it will retain its new look almost indefinitely. That's because the nickel or chromium protection provided by the Fescol process withstands wear and corrosive attack being an even harder, more durable surface than the original metal. The process has proved so successful in the salvage of worn rams that now we have them treated before installation. Then we more or less forget about them.

If you would like to know more about the Fescol process of electro-chemical deposition, and its applications in a variety of industries, please write for publication M.10.

FESCOL

FESCOL LIMITED · NORTH ROAD · LONDON N7

BRANCH WORKS: PORT GLASGOW, HUDDERSFIELD AND BROWNHILLS, WALSALL

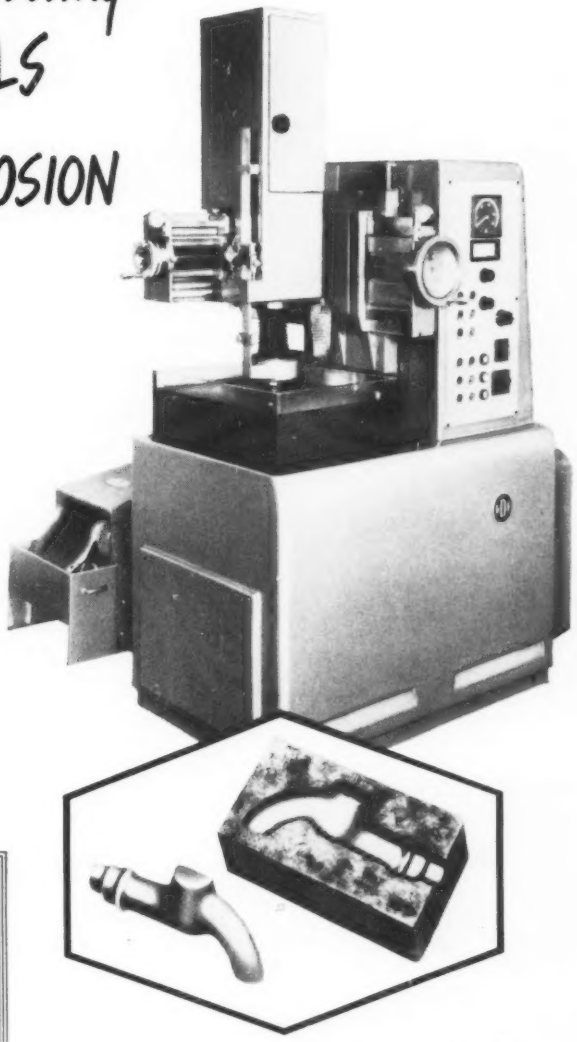
Established 1920

Sole Licensees for Australasia: De Havilland Aircraft Pty. Ltd., Milperra Road, Bankstown, N.S.W.

TGA 859

Fast, accurate cutting of HARD METALS by SPARK EROSION

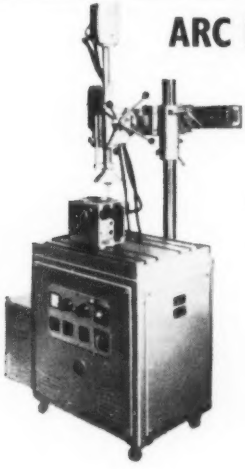
Spark Erosion Machine, Model E 1500, is designed for maximum ease of operation through careful arrangement of controls, and to provide maximum accuracy through the use of the highest quality rigid slideways and lead screws operating in conjunction with high precision scales and gauges.
The bath can be emptied and lowered, or raised and filled in a few seconds by pressing a button.
Spark Erosion is particularly suitable for cutting hardened steel and sintered metal, for making moulds and dies from masters made of brass and other materials. Suitable for screw cutting and for grinding.



Just one example of Spark Erosion Machining.

SPARK EROSION EQUIPMENT BY FRITZ DUSSELDORF

ARC EROSION PLANT



For removal of broken tools, drills, taps, reamers, etc., also machining of openings in hardened steel or sintered metal workpieces.

NRP. 2137

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PEARSON PANKE LTD

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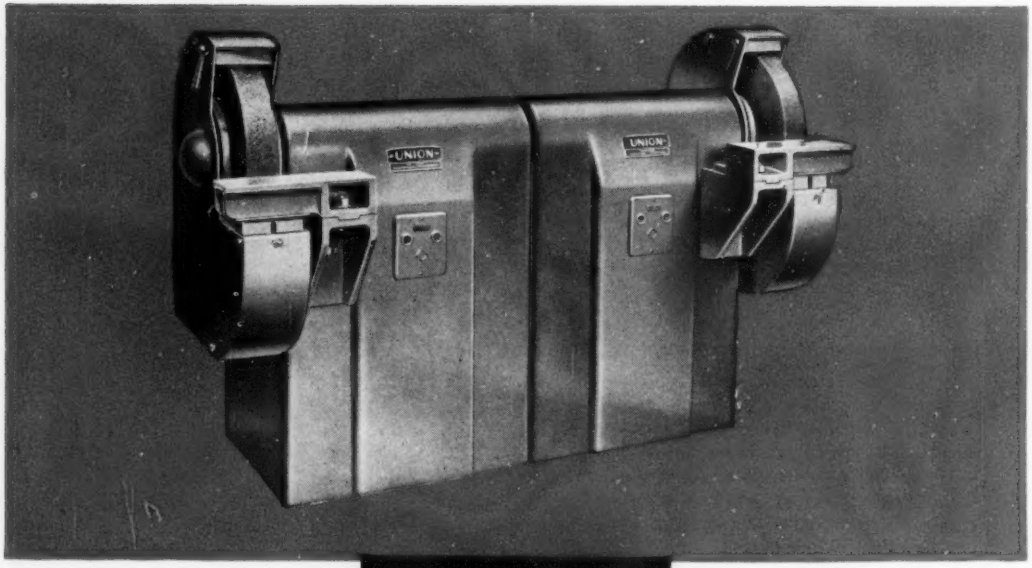

ABSOLUTE **UNION grinding machines** **DEPENDABILITY**

Top. G.20 Heavy duty, high speed grinder with independent drive to each wheel. Can be supplied with dust extraction equipment to C.I.R.A. design.

Left. Double-ended medium duty grinder. Can be supplied with coolant, eye shields, twist drill grinding attachment or arranged for side grinding.

Right. Union "Jubilee" light duty grinder or polisher. Supplied with polishing spindle in place of one or both wheels if desired.

Write for fully detailed leaflets TODAY!

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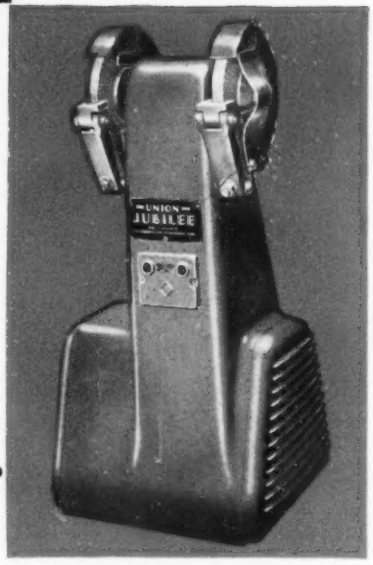
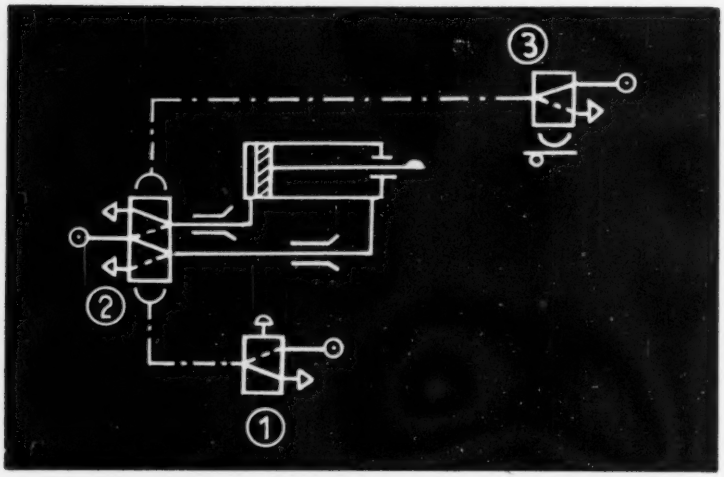


MARTONAIR TECHNICAL ADVISORY SERVICE-4



The circuit illustrated is semi-automatic—each time the push-button is depressed, the cylinder executes one cycle.

When the push-button operated three-port valve (1) is momentarily depressed, the internal connections become those shown by a dotted line, and a signal is supplied to the lower pilot port of the double pressure operated five-port valve (2) controlling the cylinder. The internal connections of this valve alter and the cylinder " outstrokes " and at the end of its stroke, trips a roller operated three-port valve (3) to reverse the internal connections of the five-port valve and return the cylinder to its original position.

The speed in each direction is independently controlled by uni-directional flow regulators arranged to restrict the air exhausting from the cylinder. Either of the three-port valves could be replaced by a three-port solenoid valve and a micro-switch or push-button.

The Martonair Technical Service is freely at your disposal at all times. Fully qualified to advise on all aspects of applied pneumatics, the Service is backed by a staff of technical representatives throughout Great Britain, and by overseas offices and manufacturing companies.

Copies of this advertisement and earlier issues in this series are available from Martonair Limited.

MARTONAIR LIMITED

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MANUFACTURERS OF PNEUMATIC HOISTS · CYLINDERS · CONTROL VALVES AND ACCESSORIES

AD. 34

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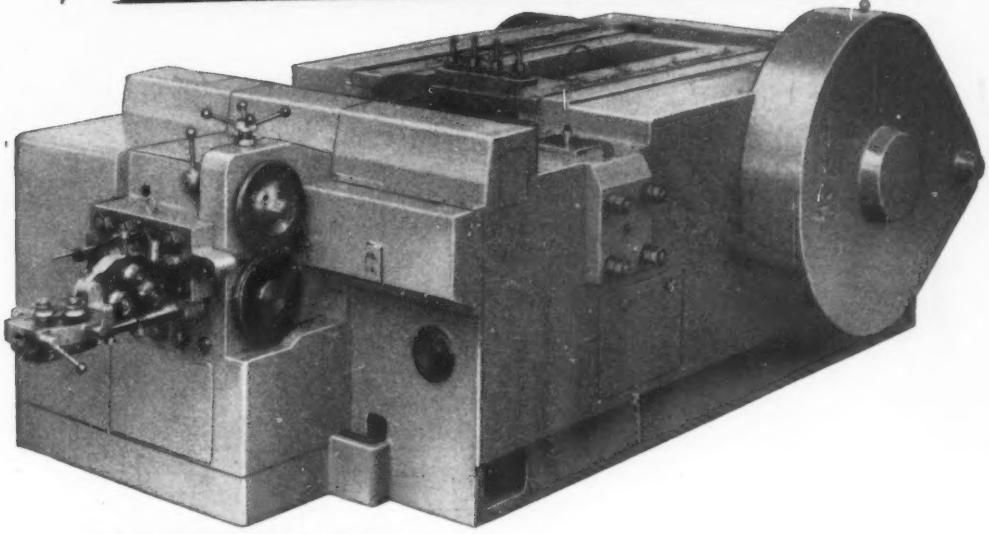
Four Stage Transverse Cold Header

makes production of many parts CHEAPER



MALMEDIE COLD HEADING

offers to cost conscious industry a real way out

★ ***REDUCING PRICES*** by using metal normally turned away as waste.

★ ***ADDS PROFITS*** by continuous fully automatic multi-stage production of parts without waste.

★ ***IMPROVED PRODUCTS*** by improving grain flow in critical corners.

Three sizes: QPB 8 100 tons Cap. Max. inlet wire 0·472 in. dia.
QPB 13 250 tons Cap. Max. inlet wire 0·710 in. dia.
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Send your problems for investigation.

Sole selling Agents for the United Kingdom

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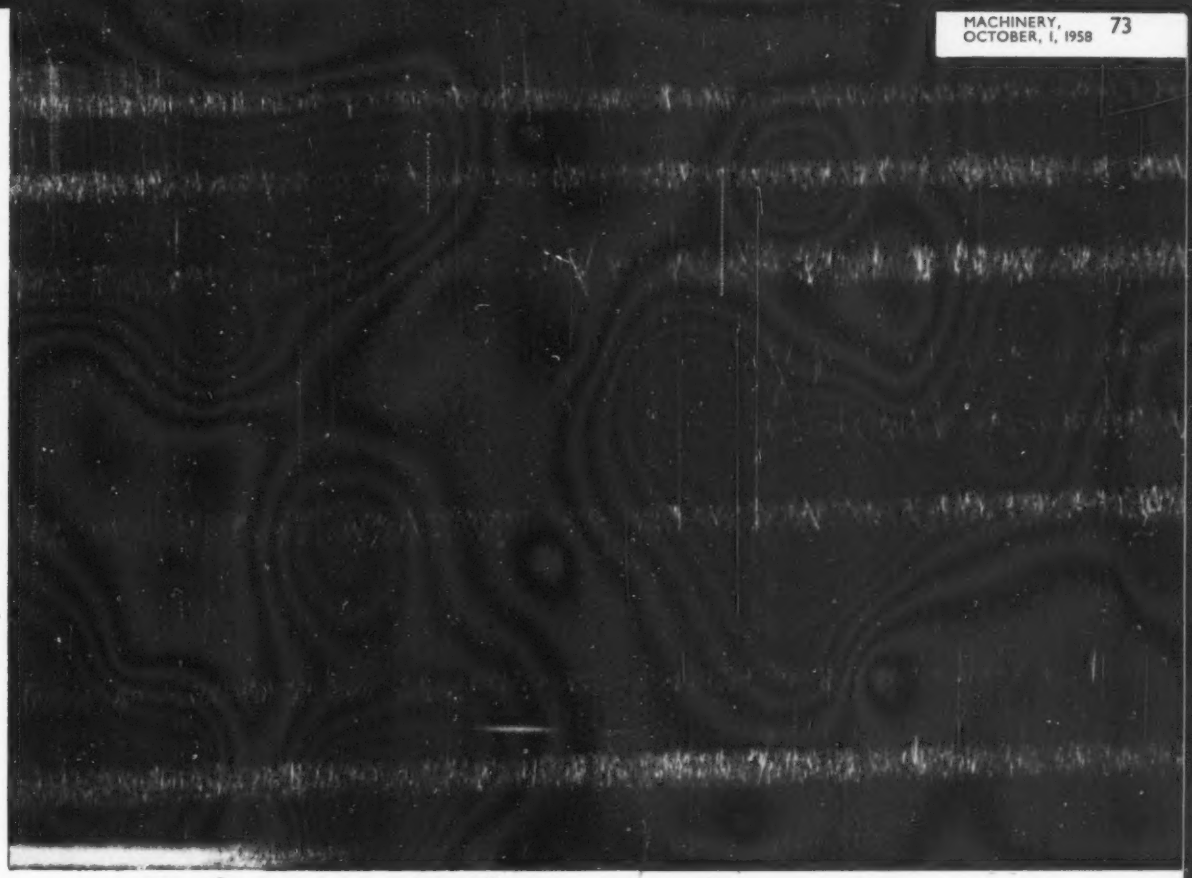

This roll looked perfect...

until **SUPERFINISH*** revealed these defects!

***GISHOLT SUPERFINISHERS ARE NOW BRITISH BUILT!**

Everybody said it was as perfect a finish as you'd ever see. A 12″ steel roll ground down to a smoothness of less than 2 micro inches — dazzlingly reflective from end to end. Not a visible defect — on the surface.

But when SUPERFINISHING began, some interesting marks appeared — longitudinal flat spots — defects produced by the prior operation and then covered up by the heat of grinding.

SUPERFINISH brings these hidden troubles out in the open — out where you can see them and recognize the cause. And if your troubles are not too serious, SUPERFINISH can correct them economically and fast.

If you have fine finish requirements it will pay you to write for details to our agents.

THE GISHOLT ROUND TABLE

represents the collective experience of specialists in the machining, surface finishing and balancing of round and partly round parts. Your problems are welcomed here.

GISHOLT MACHINE COMPANY (GB) LTD.
LONDON

A Subsidiary of the Gisholt Machine Company, Madison, U.S.A.

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Speedy-low cost precision superfinishing of lightweight parts

NAGEL

Type HHM 40 horizontal

HONING MACHINE

A versatile machine for toolroom or production. High spindle speeds permit the use of diamond hones for machining carbide or hard steel.

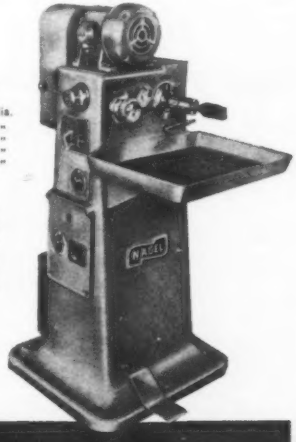
The large surface honing tools used with this machine give better accuracy and surface finish.

For bulky components, a special adjustable sliding table can be provided to facilitate the operation.

The following models are available:

Spindle Speed (infinitely variable)		Capacity
200 — 800	r.p.m.	$\frac{3}{8}$" — 2$\frac{3}{8}$" dia.
400 — 1,600	"	0·10" — 1$\frac{1}{4}$" "
200 — 1,600	"	0·10" — 2$\frac{3}{8}$" "
800 — 3,200	"	0·10" — $\frac{3}{4}$" "
400 — 3,200	"	0·10" — 1$\frac{1}{8}$" "

Nagel also produce superfinishing spindles for easy mounting on machine tools, for external honing of spigots, shafts and rolls, and for internal honing of large diameters, such as clutch faces, rings, etc.



WICKMAN LIMITED

FACTORED MACHINE TOOL DIVISION · FLETCHAMSTEAD HIGHWAY · COVENTRY

Telephone: Coventry 40351

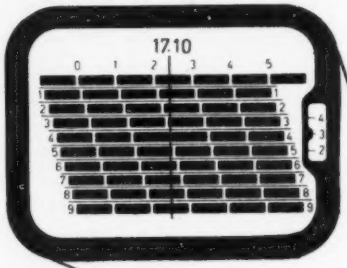
470 F 72

PERRIN MODEL AV2

JIG BORER with Optical Table

The table may be used for drilling, boring, milling and for measuring, the accuracy being controlled by a new optical system. The easily read optical image assists in rapid and positive setting, and guarantees consistent results free from errors peculiar to lead screws. A special device enables the initial point of measurements to be set at zero. Independently, two rules and pointers are provided for coarse adjustment of the table. Fine adjustment of the table is effected by means of small handwheels acting on the leadscrews through worm reduction gears. The minimum graduations in the optical system are 0·0001in. and the limit of accuracy of setting the table over the whole range is ±0·00015in. Maximum error of glass rules ±0·00012in.

POSITION 17·1243in.



2 scales as shown controlling longitudinal and transverse settings

Swiss made—reasonably priced

SPECIFICATION

Boring capacity in cast iron 4in.
Travel of spindle 4⅝in.
Infinitely variable speeds up to 3,200 r.p.m.,
three-power feeds to spindle (0·002in.,
0·004in., 0·008in.)
Table size 19⅝in. by 11in.
Longitudinal movement 16in.
Transverse movement 11in.

SOLE AGENTS IN THE U.K.

ACBARS LTD

57a HOLBORN VIADUCT, LONDON, E.C.1

Telephones : CENtral 2287-8-9, 6811-2

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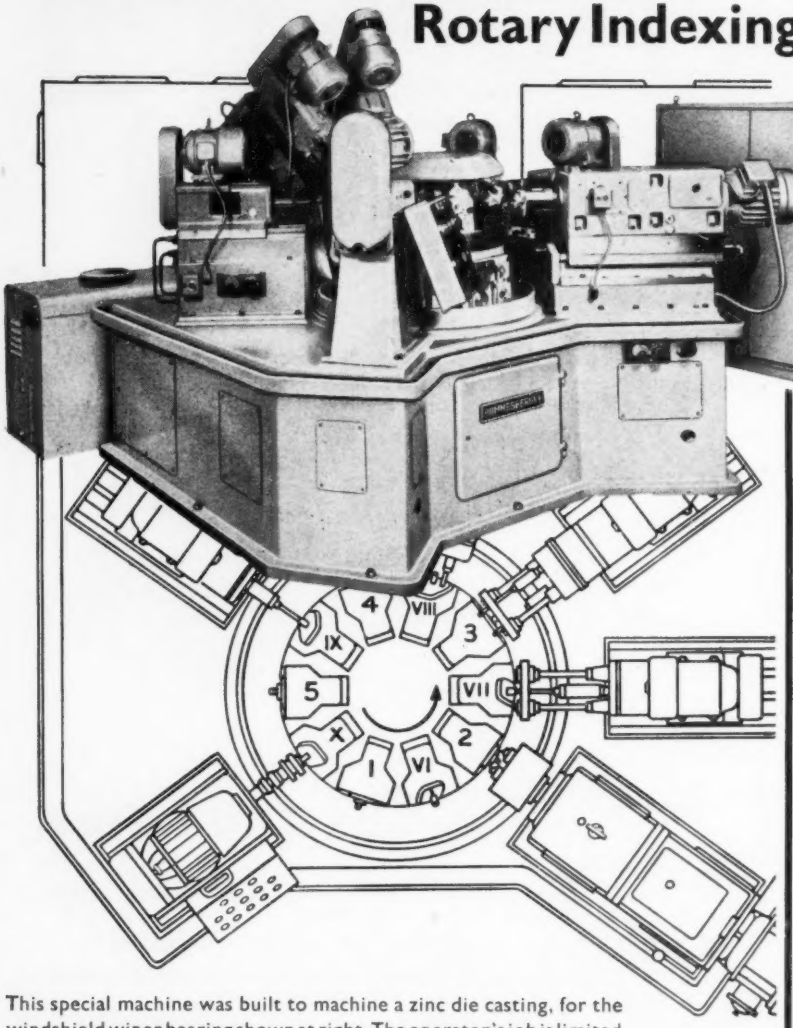
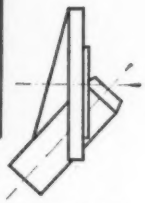
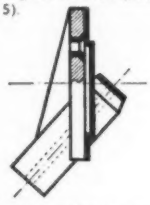
BAMMESBERGER

Rotary Indexing Machine

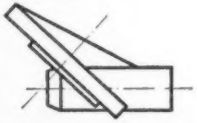




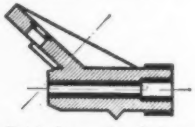
Casting loaded for machining during 1st rotation (stations 1 - 5).



Parts shown after 1st rotation (faced, drilled and spotfaced end milled).



Part premachined at stations 1 - 5 loaded for stations VI - X (2nd rotation).



Finished part after 2nd rotation (step drilled, deburred, reamed, tapped).

Output: approx. 220 pieces per hr. at 85% efficiency.

This special machine was built to machine a zinc die casting, for the windshield wiper bearing shown at right. The operator's job is limited to loading, reclamping and unloading of these parts. The machine is built up of three single-spindle drilling units, two slide units with built-on 2-spindle drilling heads, one facing unit with hydraulic shuttle table, one tapping unit and one hydraulic rotary indexing table.

DISTRIBUTORS AND STOCKISTS FOR THE UNITED KINGDOM

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MORTIMER ENGINEERING COMPANY
PROPRIETORS: S. GUITERMAN & CO. Ltd

Showroom & Sales: 204/6 ACTON LANE, HARLESDEN, N.W.10

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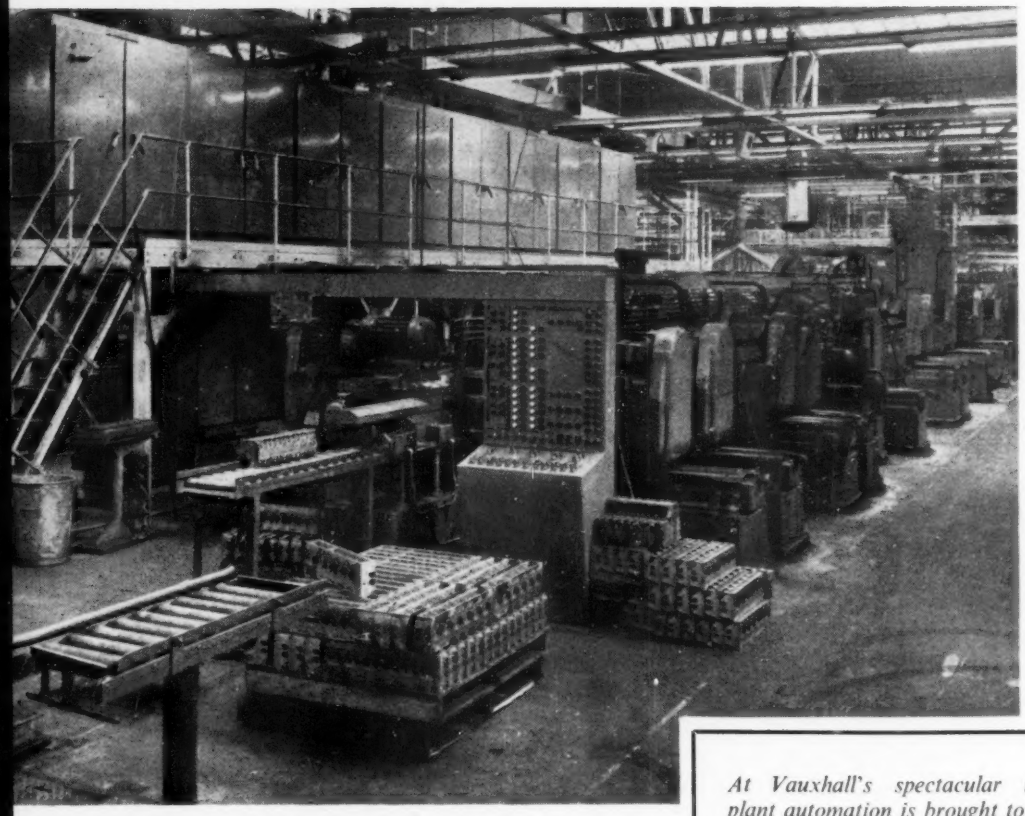
Automation at Vauxhall Motors



At Vauxhall's spectacular new plant automation is brought to the highest pitch of efficiency yet achieved. Pictured is the Asquith 18-station Drilling Transfer Machine used for machining all Vauxhall Victor, Velox and Cresta cylinder heads. With a total of 273 spindles it absorbs 269 H.P., cycling at 70 pieces/hr. performing all drilling, reaming, countersinking, boring and tapping operations. The sequence of all the fixtures, transfer bar, tilting and turning stations is actuated by VICKERS-DETROIT *Oil Hydraulic Equipment.*

As in the many other fields of industrial production where continuous processes are called for VICKERS-DETROIT Oil Hydraulics are specified by the largest organisations to reduce cost, improve uniformity and provide flexibility— advantages which are at the service of every industrialist, whatever the size of plant.

British Made VICKERS-DETROIT OIL HYDRAULICS

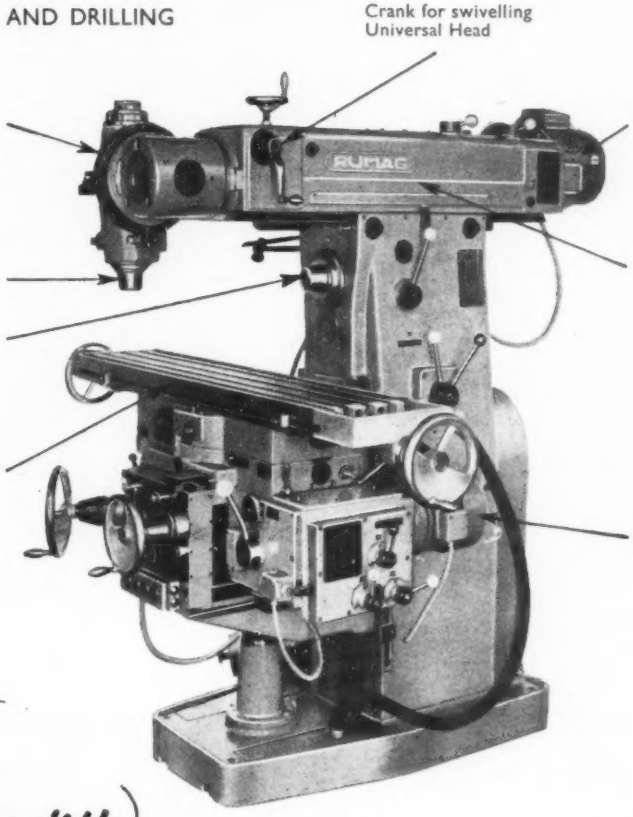
For further details please write for publication 1/39

by **STEIN ATKINSON VICKERS HYDRAULICS LIMITED**

S.A.V. HYDRAULICS **197 KNIGHTSBRIDGE, LONDON, S.W.7**

THE NEW RUMAG MULTIPURPOSE MODEL RU2-VS MILLING MACHINE

FOR TOOL ROOM OR PRODUCTION
FOR HORIZONTAL, VERTICAL, ANGULAR AND HELICAL MILLING
FOR UP OR DOWN MILLING
FOR BORING AND DRILLING



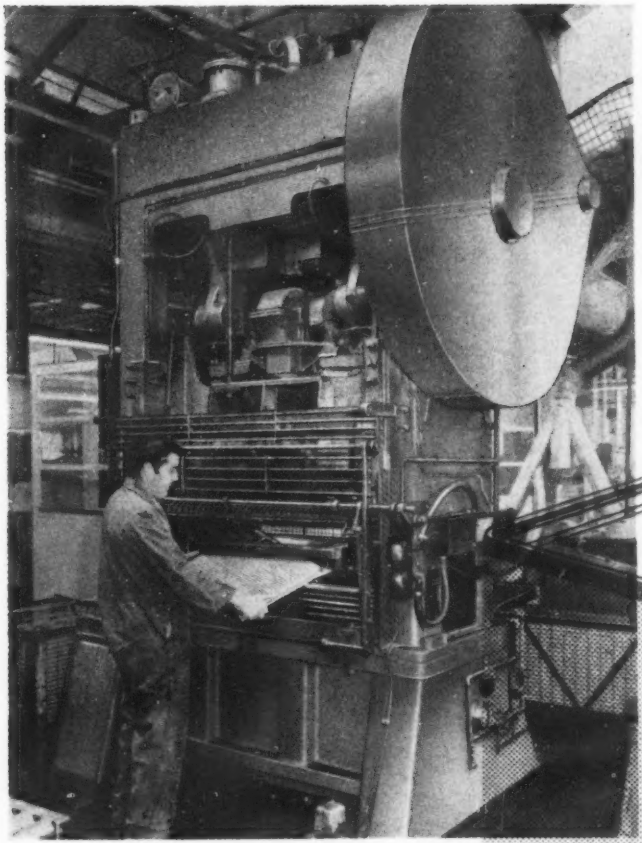
Early delivery

Table 39½in. by 1in. or 49¼in. by 11in. Spindles bored No. 4 M.T. or No. 40 A.S.A. 12 horizontal spindle speeds 25 - 1,050 r.p.m. 24 vertical spindle speeds 60 - 2,990 r.p.m. 12 auto feeds and rapid traverse in all directions. Built to Schlesinger limits.

Available also with table up to 59in. by 13¾in. and infinitely variable speeds and feeds.

THOKA **MACHINERY SUPPLIES LTD.**

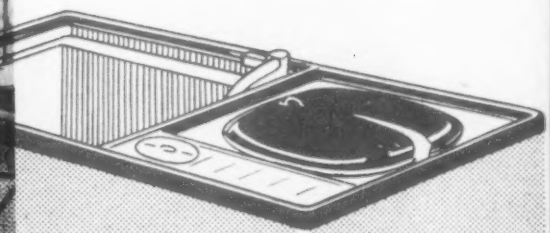
2 DRAPERS GARDENS, LONDON, E.C.2. Phone: NATional 7391



Round and about with BLISS

The ever-increasing efficiency and reliability of the production lines at Hoover (Washing Machines) Ltd., Merthyr Tydfil, result from intensive studies of advanced equipment and techniques.

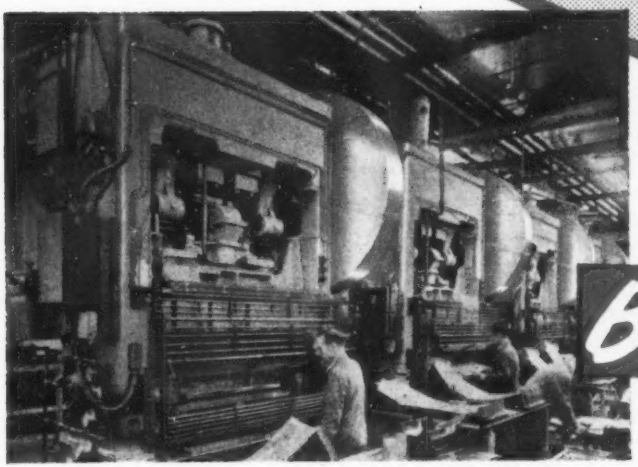
A case in point is a battery of Bliss 135-ton, straight sided, double-crank presses here seen producing draining boards for Hoover's famous washing machines.



BLISS

6-60s

AT HOOVER



BLISS

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London Office:
2/3, THE SANCTUARY, S.W.1
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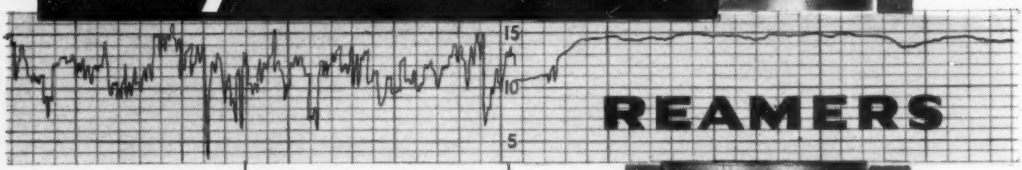
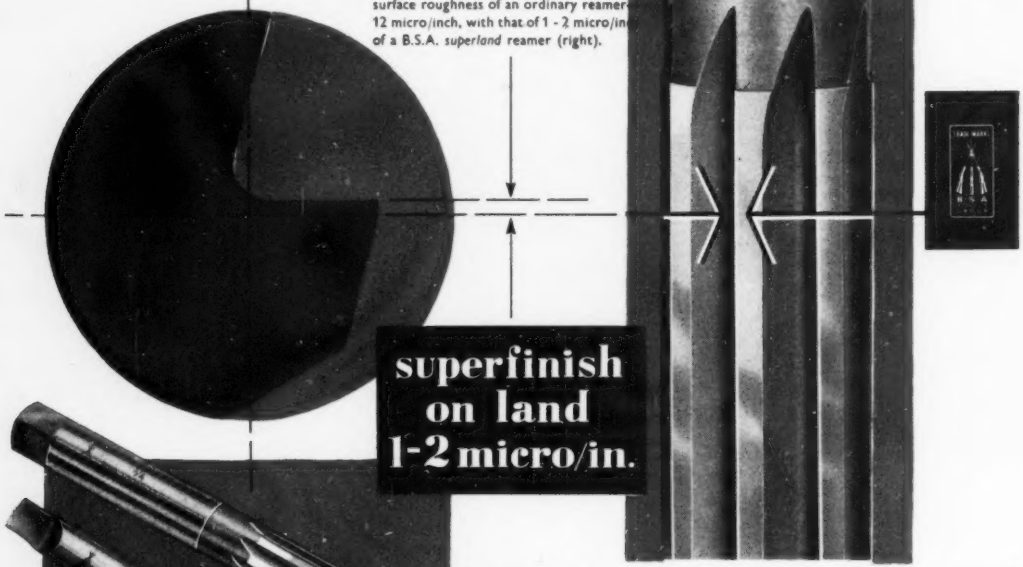
superland



REAMERS

Reproduction of recording chart compari
surface roughness of an ordinary reamer
12 micro/inch, with that of 1 - 2 micro/in
of a B.S.A. *superland* reamer (right).



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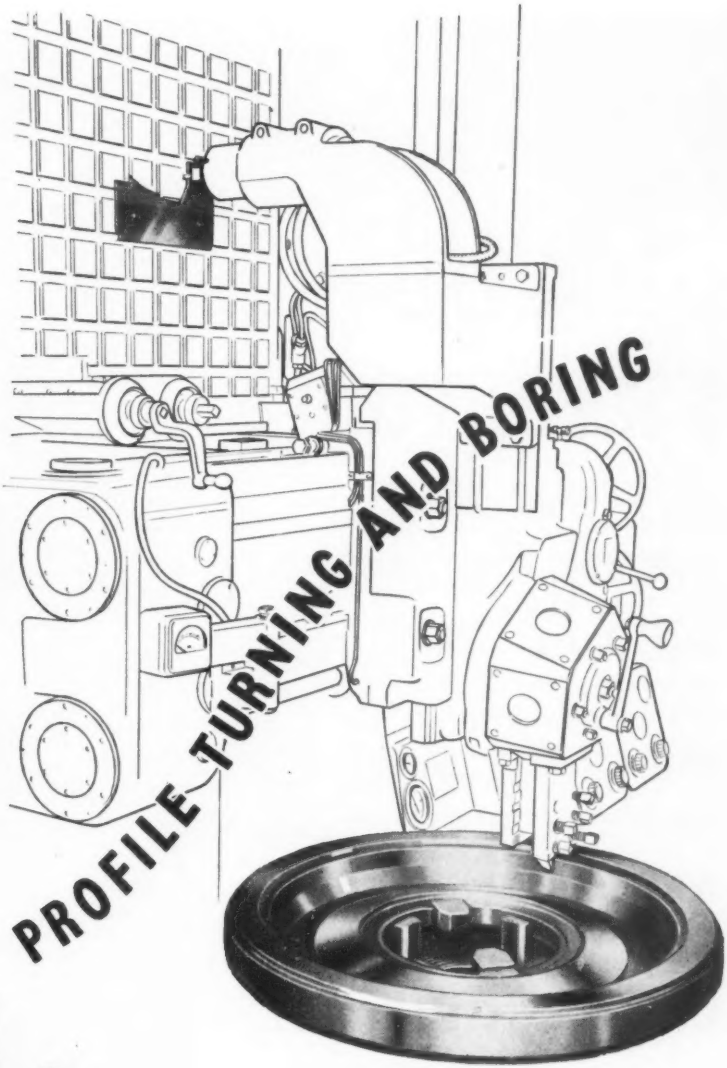

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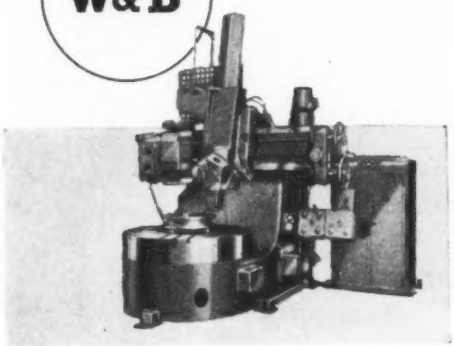

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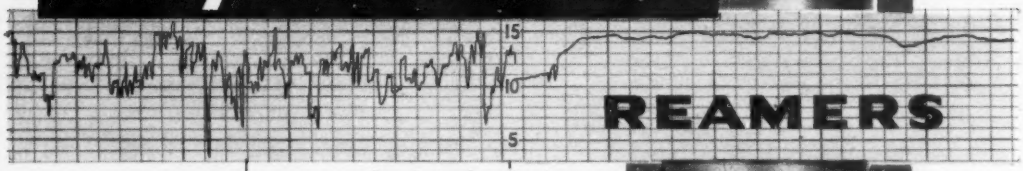
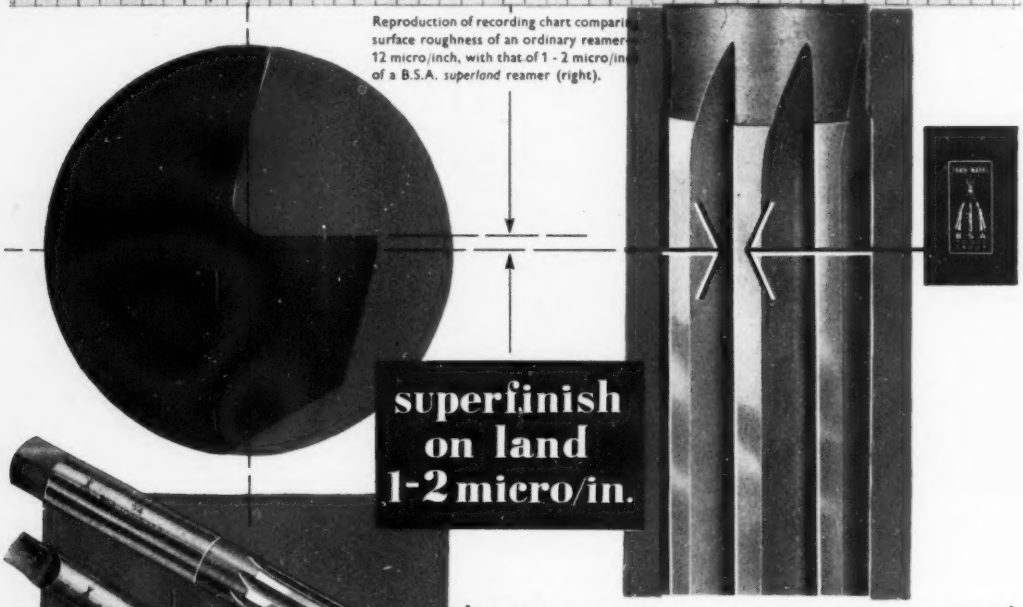


Reproduction of recording chart comparing surface roughness of an ordinary reamer 12 micro/inch, with that of 1 - 2 micro/inch of a B.S.A. *superland* reamer (right).



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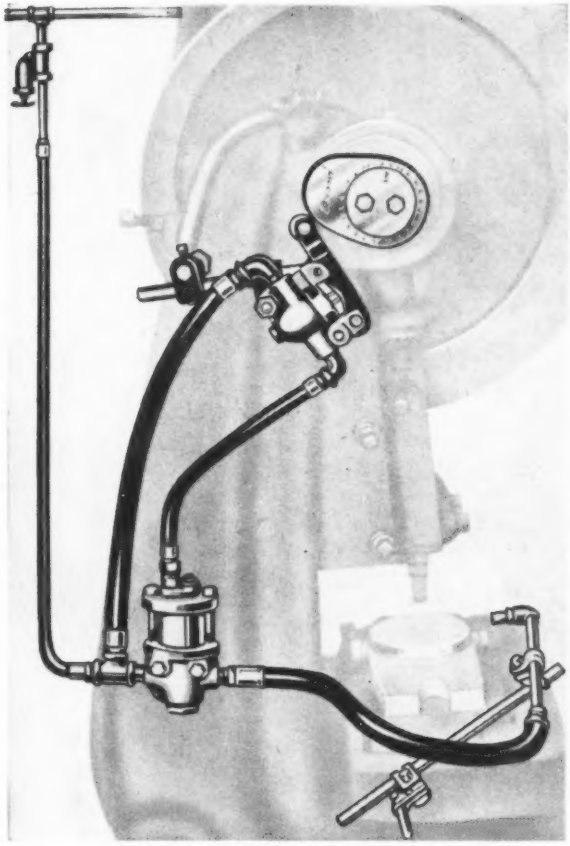

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CONTENTS

Abstracts of Principal Articles

Aspects of Russian Engineering Industry P. 748

The work of the Experimental Scientific Research Institute for Metal-cutting Machines (ENIMS), in Moscow, was discussed in the preceding article in this series, and it was pointed out that an important branch of the institute's activities is the design of automatic machining lines. Among these lines may be noted an automatic piston plant, now installed in one of the leading Russian motor car factories. The sequence of operations in this plant is here described, and the layout and functioning of automatic lines for the production of gears and rotor assemblies are discussed. It is pointed out that the institute has been concerned with the reduction of idle times, and has developed "flexible" loading and transfer systems whereby such times are substantially reduced, and the machines in the line can be operated completely independently. Two lines under construction in the institute machine building plant are examined, and loading mechanisms for shafts are described. Details are also given of an automatic dynamic balancing and correction-drilling installation. (MACHINERY, 93—1/10/58.)

Hot-sizing Titanium and Heat-resistant Steel Parts .....P. 762

In the production of components from titanium and other heat-resistant steels, particularly when these have to be formed from sheet material, difficulty is frequently encountered in maintaining the required limits of accuracy on the dimensions. It is difficult to produce small corner radii in such metals, and when parts have been formed in hydraulic presses, or by drop-hammers, they almost invariably have wrinkled flanges and warped surfaces. To overcome these difficulties, the Los Angeles Division of the North American Aviation, Inc., U.S.A., has developed several prototype hot-sizing presses, on which patent applications are pending. On these machines, parts are hot-sized in less than 8 per cent of the time formerly required for bench working, and dimensional limits of the order of $\pm$ 0·003 in. can be maintained. The machines have electrically-heated top and bottom platens, the latter being hinged at the rear to facilitate loading the work. Parts are sized over the same form blocks which were employed on the hydraulic presses, and when the top platen has been lowered into place, pressure is exerted by horizontal and vertical hydraulic cylinders to force the work against the die blocks. This pressure is maintained for between 5 to 10 min., when the parts are removed and allowed to cool at room temperature, without restraint. (MACHINERY, 93—1/10/58.)

Design Data for Flat Air Bearings when Operating Under Steady Conditions of Load .....P. 765

In order to provide design information for at least one type of flat air bearing, a fundamental investigation is at present being carried out by M.E.R.L., East Kilbride. Tests have been made on two bearings which are similar in design, but have different bearing areas, with a view to establishing a relationship between bearing area, orifice diameter, bearing lift, load, and set-back of the orifice face from the bearing surface. From these tests, empirical equations relating to orifice diameter, bearing area and lift, load, and stiffness, for a supply pressure of 40 lb. per sq. in. have been obtained. At the end of the article, there is a design example, which shows how the results of the experiments can be applied in practice. The procedure adopted for the tests is fully described, and numerous curves are given to illustrate the relationships of the various basic factors mentioned above. (MACHINERY, 93—1/10/58.)

Improved Facilities for the Production of Castings by the Mercast Process .....P. 777

At the new Crawley works of Sankey-Telcon, Ltd., which is devoted to the production of intricate components by the Mercast process of precision investment casting, the pattern- and mould-making shop, the foundry and finishing department, and the toolroom, are housed in a single building. To reduce fire risk, a separate building has been provided to house the mechanical refrigeration plant for the tanks wherein the mercury patterns are frozen and then invested with zircon-base ceramic slurry to form the shell moulds. Furnaces of different types have been installed for the melting of high-alloy steels, and aluminium and copper base alloys, and a 56-lb. vacuum furnace is available for both casting and melting duties. In the article, details are given of a complex built-up mould for the production of mercury patterns for an intricate gas turbine component. Reference is also made to a second gas turbine part, which has been produced by the Mercast process, and is noteworthy for the fact that there are considerable variations in cross-sectional dimensions. (MACHINERY, 93—1/10/58.)

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If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

IN FORTHCOMING ISSUES

The production of cash registers and accounting machines—Producing electrical components on Variomatic machines—Friction and lubrication of machine tool slideways—The S.B.A.C. Static Exhibition at Farnborough

Carbide Tool Development

Continual and successful efforts have been made over a considerable period of years to improve the metal removal performance of cemented carbide cutting tools, and there have been three distinct phases of development. In discussing these stages, during the course of a paper read recently before the American Society of Tool Engineers, Mr. W. L. Kennicott pointed out that with the brazed tip tool, which was almost invariably employed initially, limitations of metal removal rate are largely attributable to thermal strains. These strains result from the brazing operation and although various measures have been taken to reduce their severity, they are inevitably present and are necessarily more pronounced in large than in small tips. Such strains obviously have a weakening effect and thus increase the risk of breakage particularly when large tips are subjected to heavy cutting forces. Brazed-tip tools, however, have been—and still are—very widely employed and continue to give excellent results, provided that the conditions of application do not exceed their capabilities.

To overcome the limitations imposed by brazing strains, some tools for heavy-duty operations were provided with tips of a form generally similar to that previously employed, but secured in position by mechanical clamping. Subsequently, improvements in carbide materials enabled them to be employed successfully for negative rake cutting, and holders for "prismatic" inserts of triangular, square, and round cross section were introduced. It was found that with mechanical clamping higher metal removal rates could be obtained, but a fresh limitation then became apparent. Both the early type of clamped tip and the prismatic insert are of appreciable mass, and it has been found that whereas the tools perform extremely well at reasonable cutting speeds, and even at high speeds where the cycles are short, heat checking tends to occur if high speed cutting is continued without interruption. This trouble is attributable to the steep thermal gradient that develops between the heated tip and the bulk of the carbide, which remains comparatively cool, and the position is aggravated by the fact that carbides with high resistance to top wear or cratering have low thermal conductivity. When heat checking occurs, moreover, it may not be possible to eliminate all cracks at the re-grinding operation, and the life during subsequent runs may therefore be reduced.

With tools of the types so far considered, chip breakers are formed by grinding the tips or inserts, and the carbide material employed is required to fulfil three functions. It must provide a cutting edge for shearing the chip, backed up by the relatively flexible steel holder it must provide support for that cutting edge, and it must provide a surface against which the chip can be effectively broken or deflected.

An attempt to separate these functions, and thus enable a better combination of properties to be provided, led to the introduction of tools of the "throw-away" tip type. Here, the cutting portion is comparatively small and thin, with the result that thermal gradients are reduced with important advantages, and as each edge is intended to be used once only, subsequent runs cannot be affected by any heat checking that may occur. Preferably, the tip should be carried by a carbide holder of very high modulus, to provide the maximum rigidity. Such holders have been made, but are not yet in common use, and a hardened alloy steel holder, fitted with a high-strength carbide anvil on which the tip rests, affords an effective compromise. Finally, the chip breaker, which may also serve to distribute the clamping pressure, can be made as a separate piece from a carbide best suited for this duty.

With throw-away tip tools, harder carbides can be employed than hitherto for the cutting elements, and metal removal rates have been further increased. When attempts have been made to raise cutting speeds beyond certain values, however, trouble has been experienced due to top wear of the cutting tip. Investigations have shown that when a tool is cutting at high speed, the maximum temperature is reached on the top surface at a distance from the cutting edge approximately equal to the thickness of the chip. For a given work material there is a particular cutting speed which produces a tip surface temperature such that welding begins to occur between the chip and the tool, and any further increase in speed results in disproportionately rapid wear. It has been found that these conditions can be simulated if a piece of steel and a piece of carbide are heated while being held in contact under pressure, and new carbides are being developed with the object of raising the temperature at which welding occurs.

There is every reason to suppose, therefore, that metal removal rates will continue to rise, and in this connection it is pointed out that in some instances it may be preferable to increase the feed rather than the speed to achieve the desired result. In this way, a higher rate of removal can be obtained for a given rise in tool temperature.

Aspects of Russian Engineering Industry

Some Impressions Based on a First-hand Study of Soviet Plants

The growth of the Russian engineering industry was traced in the first article in this series*, and the expansion of machine tool production, also the design of some recent Soviet-built machine tools, was discussed. Subsequent articles were concerned with the organization and products of the Ordzonikidze and Sverdlov machine tool plants in Moscow and Leningrad, respectively, and the Moscow Cutting Tool Works, where gear checking equipment is built, in addition to broaches, gear shaping and shaving cutters, hobs and standard milling cutters and lathe tools. The two most-recently published articles in the series were concerned with the activities of the Central Scientific Research Institute of Technology and Machine Building (TsNIITMASh), and the Experimental Scientific Research Institute for Metal-cutting Machines (ENIMS), both of which are located in Moscow. These institutes render important services to industry, and are responsible for the introduction of many new metal-working processes.

As its name implies, ENIMS is more closely connected with the development of new metal-cutting techniques and the design of machine tools. It has a large design department and an associated machine tool building plant, and was responsible for the construction of the early Russian transfer machines. Since the building capacity of the ENIMS plant is limited, the design and building of conventional transfer machines has been transferred to the Ordzonikidze plant, and, in recent years, the institute has turned its attention to the development of automatic machining lines for parts that must be rotated during the cutting operations—for example, shafts and gears. A brief reference to this branch of the institute's activities was made in the preceding article in this series, and some of the lines that have been built, or were under construction at the time of our visit, will now be described and illustrated.

AUTOMATIC PISTON PLANT

During the period from 1947 to 1952, ENIMS carried out theoretical investigations and experimental work in connection with the automation of metal-cutting operations generally. Based on this work, and in collaboration with a number of Soviet machine tool plants and other organizations, the institute undertook the construction of an automatic installation for the production of pistons. At the time of our visit, it was not possible to see this piston plant in operation, but details of its layout and the functioning of its various elements were furnished by a senior engineer of ENIMS.

The installation is completely self-contained, raw material being fed in at one end, and pistons, packed in matched sets, being delivered from the other end of the production line. The plant has now been in operation for a number of years, and for the past three years has maintained the designed output rate of one piston every 9 sec., at an operating efficiency of 80 to 85 per cent. During the first 2 to 2½ years that it was in use, the plant was supervised by ENIMS engineers, who were responsible for a number of detail modifications and improvements that were found necessary in the light of operational experience. The plant has now been installed in the Gorki motor-car works, where it is in use for two 8-hour shifts each day.

A general diagrammatic layout of the plant is given in Fig. 1. Raw material, in the form of aluminium alloy ingots, is fed into the loading unit *A*, and is delivered to the furnace *B*, associated with an automatic die casting machine. Castings are produced at the roundabout installation *C*, and in order to maintain the required output, multiple dies are used. Closing and opening of the dies, the advance and withdrawal of cores, and ejection of the piston castings are carried out automatically. Pistons, complete with runners and risers, as indicated at *c*, after ejection from the dies, are transferred to the trimming machine *D*. This machine is equipped with two horizontal spindles which carry circular saws, and a vertical spindle fitted with a face milling cutter, whereby the runner and riser of each casting is removed, and flash is trimmed from the open end of the piston, as indicated at *d*. The scrap material is returned to the melting furnace by a conveyor, and the piston castings, after being ejected from the trimming machine, are loaded automatically into large wire-mesh baskets on a conveyor which

* MACHINERY, 93/4–2/7/58; 93/137–16/7/58; 93/288–6/8/58, 93/344–13/8/58; 93/456–27/8/58; and 93/572–10/9/58.

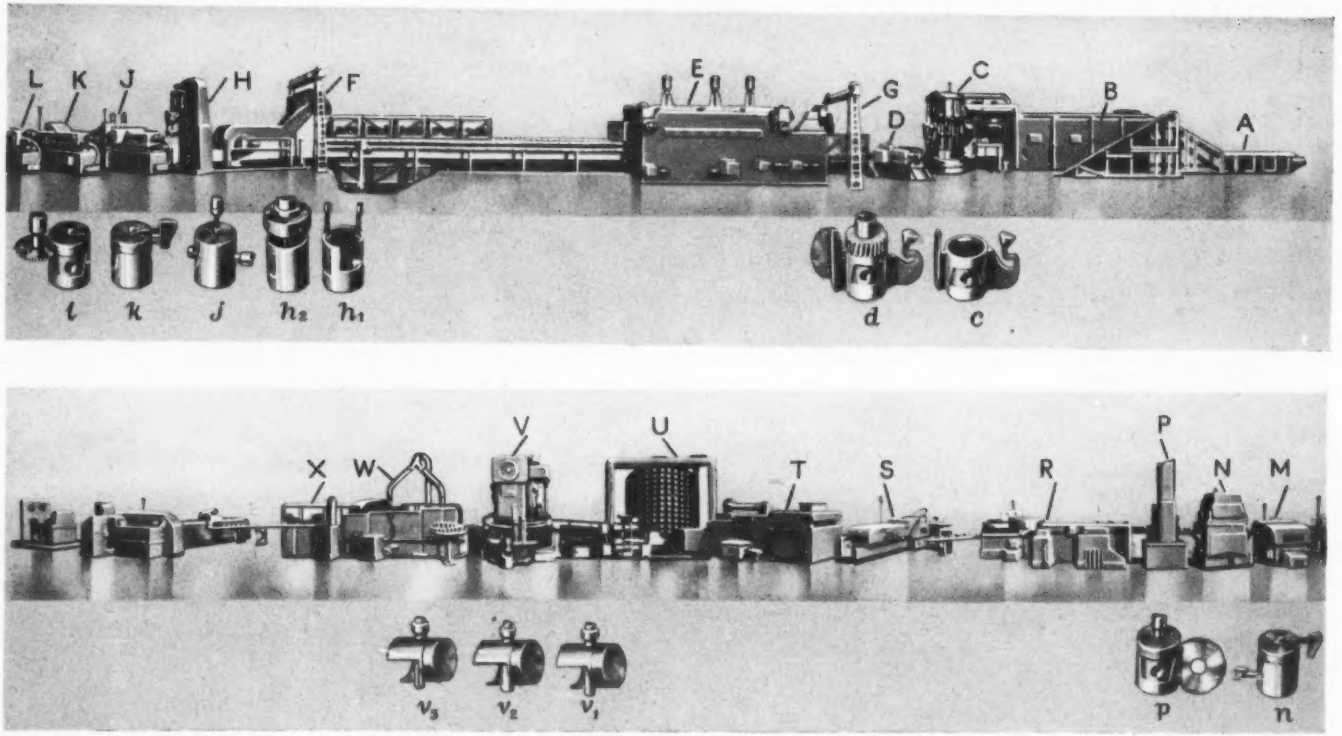


Fig. 1. Diagrammatic Layout of an Automatic Plant for the Production of Pistons. Raw Material in the form of Ingots is Fed in at One End, and Pistons, Packed in Matched Sets are Delivered at the Other. With the Plant Operating at 80 to 85 per cent Efficiency, One Piston is Completed Every 9 sec. This Plant is Now Installed at the Gorki Motor Car Factory. The Starting End of the Line is at the Right in the Upper View, and the Finishing End at the Left in the Lower View

passes through the heat treatment furnace *E*.

As may be seen, the conveyor extends for some distance beyond the exit end of the furnace, and serves as a work bank between the first section of the plant (comprising the casting, trimming and heat-treatment equipment), and the next group of machines. At the end of the conveyor, there is a mechanical elevator and unloader *F*, whereby the baskets are raised and then tilted, so that the heat-treated pistons pass down a chute to the first machine in the second section of the plant. Empty baskets are lowered and transferred to a return

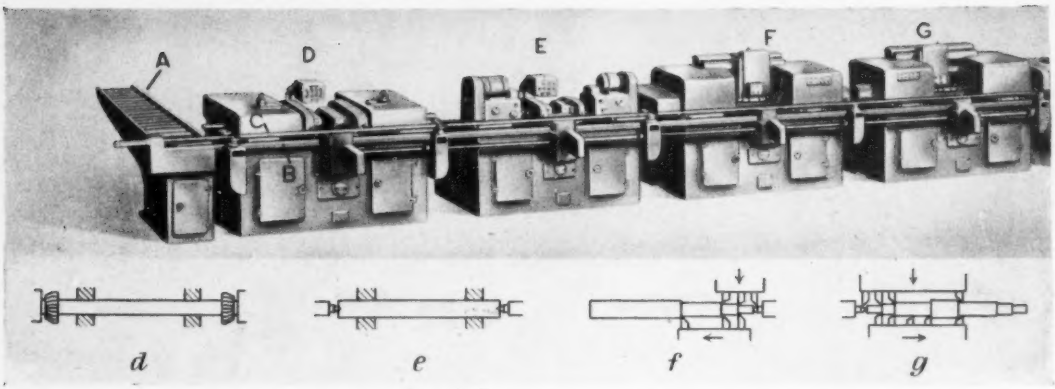


Fig. 2. Perspective View of the Automatic Transfer Line for the Production of Electric Motor Rotor Assemblies which has been Built by ENIMS. The Operation Stages are Indicated Below, and Include Serration Rolling, Assembly of the Lamination Stack and Dynamic Balancing. Individual Machining Units are Employed and are Linked by a Hydro-mechanical Transfer and Loading System

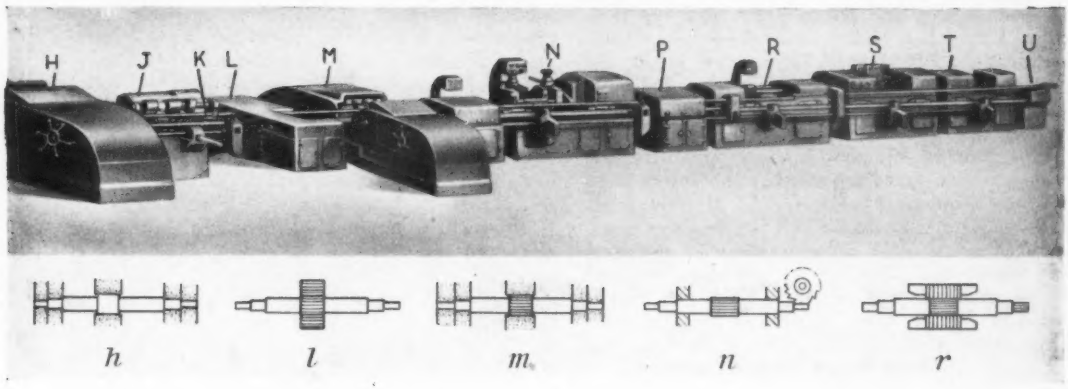
conveyor, below the first, and are delivered to the entry end of the furnace, where they are raised by another elevator *G*.

The first machine in the second section of the plant, indicated at *H*, has two machining positions. At the first position, two holes in cast lugs at the bottom of each piston are finished by core-drills in a multi-spindle adapter, as shown at h_1. A shallow register-bore is then machined at the bottom of each piston skirt by means of a boring head on a vertical spindle. As seen at h_2, the cutter head has two diametrically-opposed tool bits, and the register-bore and holes are employed for location purposes at the succeeding machining stages. The next unit (*J*) has vertical and horizontal heads, and a centre-hole is drilled in a boss on the crown of each piston, while the gudgeon-pin holes are rough-bored, these operations being indicated at *j*. Next, the pistons are delivered to the special lathe *K*, where the crown is faced and the piston-ring grooves are formed by ganged tools, as shown at *k*. Milling of the expansion slots is carried out on the next machine *L*, as indicated at *l*, and from this stage the pistons are delivered to an automatic index drilling machine *M* whereby the oil holes are produced at the bottom of the scraper ring groove. The pistons are finished turned on the special lathe *N*, and, as indicated at *n*, one tool is applied to face the crown and another to machine the skirt.

From the special finish-turning lathe, the pistons are delivered to a multi-spindle milling machine *P*, on which the skirt is split and the boss on the crown is removed, as may be seen at *p*. Next, the pistons are passed through automatic equipment whereby each is weighed, and its weight is then adjusted to bring it within a specified tolerance by boring the open end of the skirt, this equipment being indicated at *R*. After weight adjustment, the pistons are chute fed to the entry end of a centreless grinding machine *S*, for finishing the external surface, and are then transferred to a mechanized washing installation *T*. Pistons pass through this unit in two parallel lines, supported on longitudinal rollers, and are rotated beneath jets of solvent. The washing installation is the last unit in the second section of the plant, and clean pistons are conveyed from the exit end of the washer to the loading position of a work storage bank *U*. This work bank consists of a large indexing drum, mounted on a vertical shaft, and the pistons are thrust into nests which are arranged in vertical rows round the drum.

Pistons are delivered from the work bank *U* to the loading unit for the first machine *V* in the third section of the plant. This machine is of the rotary transfer type, and provides for finishing the gudgeon pin holes. The operations include forming the circlip groove and semi-finish boring, finish boring, and reaming, as indicated at v_1, v_2 and v_3, respectively. These operations complete the machining stages in the production sequence, and the pistons are passed to a mechanized installation *W* for final washing.

Mechanical inspection follows, and is carried out in two stages in the equipment *X*. At the first stage, the various diameters of the skirt are gauged, and the piston is checked for ovality



and taper, the pistons that are within the specified tolerances being graded according to diameter. The gudgeon pin bores are checked at the second stage, and again the pistons are sorted into size grades. From the inspection installation, the pistons are chute fed to an automatic greasing unit, where they are loaded into holders on the periphery of a rotating drum, the lower part of which passes through a bath of protective lubricant. Pistons pass from the exit end of the greasing unit to a wrapping machine, where each is wrapped in greaseproof protective paper. From this machine, matched sets of six pistons are delivered to an automatic packing unit, where they are placed on a carton blank, which is then folded and formed into a box, and finally sealed.

Although, initially, various difficulties were experienced in connection with the introduction of the automatic piston plant, satisfactory solutions have been found, and the plant is now stated to be producing pistons more cheaply and to higher standards of quality than any other factory in the Soviet Union. The setting up of the automatic plant, and the solution of the many specialized technical problems involved, has provided excellent training for engineers engaged in the planning of complex automatic production processes, not only in the U.S.S.R. but also in other countries of the Communist *bloc*. Experience gained from the operation of the plant, and earlier production lines, has enabled basic theoretical principles to be established for the design of automatic production facilities, concerning, for example, the subdivision of the production lines into sections, the size and position of work banks, and the coefficent of utilization (and its determination at the planning stage).

As a result of the success of the Gorki automatic piston plant, ENIMS has been asked to undertake the design of similar plants for the mass-production of pistons of various types, for other motor-car and tractor factories in the Soviet Union. Reference is made to one of these plants in a recent issue of the Russian journal *Stanki i Instrument**, and it is pointed out that the machining arrangements are basically the same as in the original plant, although the sections are grouped differently. There are four identical parallel lines of machines, arranged in pairs, with reversible conveyor-type work-banks between the lines forming each pair. Vibrating conveyors are widely employed for feeding work to the machines. Of the eleven machining units in each line, six are of the same design as in the original plant (apart from such modifications as are necessary to cater for the smaller dimensions of the new piston), three units are based on the earlier designs, and only two units are completely new.

AUTOMATIC TRANSFER LINE FOR ELECTRIC-MOTOR ROTORS

Following the construction of the piston plant, a number of other production lines for "rotating" parts have been designed and built at ENIMS. These lines have differed from conventional transfer machines in that they are built up from standardized machining units which are connected by work-handling equipment, each machining unit being completely self-contained, and capable of operating as part of an automatic transfer line, or independently. To date, the units that have been developed include facing and centring machines, multi-tool lathes, gear shapers and hobbers, and centreless grinders. Many of these units were designed and built for the automatic transfer line for electric-motor rotors, which was

* *Stanki i Instrument*, 29/3-May, 1958: "Noprosy Avtomatizatsii v Rabotie ENIMSa" ("Automation Problems in the Work of ENIMS"), by A. P. Vladzievsky.

constructed after the piston plant, and the time required for their design and development was considerable. They were fully tested before the transfer line was put into operation, and have been proved satisfactory in practice, under production conditions, and are now available for incorporation in any new lines for products that require similar machining stages. In consequence, the time required for the design of subsequent machines, and their design and development costs, has been substantially reduced. We were informed that the design time for an automatic transfer line is usually from 9 to 12 months, and that a period of 2 to 2½ years is required from the start of the initial designing and planning until the line has been completed, ready for production.

A perspective view of the first automatic transfer line for electric-motor rotors is given in Fig. 2, and it may be of interest to note that there are four such lines at present in operation in factories in different parts of the U.S.S.R. Pre-cut lengths of bar material are loaded into the gravity-feed chute *A*, and are fed, one at a time, into the transfer trough *B*, in front of the machining units. The lengths of bar are advanced along the trough *B* by an overhead shuttle bar *C*, and are delivered to the loading unit of the first machine *D*, which provides for face-milling both ends of the bar square and to length, as indicated at *d*. Mechanically driven, the loading unit has a horizontal ram with a single pair of gripping fingers. At the end of each machining cycle, the ram advances with the fingers open, until the latter embrace the milled workpiece in the machine. The fingers are then closed, the clamps of the machine are released, and the ram is withdrawn, so that the workpiece is moved clear of the machining zone. At the end of the ram withdrawal movement, the workpiece is aligned with the transfer trough, and the jaws are opened before the shuttle bar *C* is moved to the right. During the travel of the shuttle bar, a fresh blank is advanced between the jaws, and the milled workpiece is thrust clear, into the next section of the transfer trough. Then, the jaws are closed, the ram is moved towards the machine, carrying the blank to the cutting position, where it is clamped, before the jaws are again opened, and the ram is withdrawn. It will be appreciated that none of the unloading and loading operations are "overlapped" with the cutting cycle of the machine.

From the milling unit, the workpiece is advanced to the loading equipment for the double-ended centre-drilling machine *E*, and, again, it is carried to the cutting position and clamped between V-jaws, after the previously-machined workpiece has been removed. Centre-holes are drilled to a predetermined depth at each end of the workpiece, as indicated at *e*, in readiness for two series of turning operations on the special multi-tool lathes *F* and *G*.

The loading and unloading arrangements for these machines are generally similar to those that have been described, and the operations performed are shown diagrammatically at *f* and *g*. Each machine has a longitudinal traversing slide at the rear, and an overhead in-feeding slide, and is equipped with a hydraulically-operated tail-stock and automatic work-driver. The lathe *F* has the headstock at the left-hand end of the bed, and the rear slide moves to the left for cutting, whereas on the lathe *G*, the headstock, and direction of cutting traverse, are to the right. Three diameters, two shoulder faces and a chamfer at one end of the workpiece, which will eventually form the "pulley" end of the rotor shaft, are machined by the lathe *F*. Four diameters, two shoulder faces and two chamfers are machined by the lathe *G*.

From the lathe *G*, workpieces are advanced along the transfer trough to the entry end of a centreless grinding machine *H*. The overhead shuttle bar passes through this machine, above and between the grinding and control wheels, and is coupled to a hydraulic ram that projects from the operating and control unit *J*. Multiple wheels are fitted to the centreless grinding machine and provide for semi-finishing the central portion and two diameters at each end of the workpiece, as indicated at *h*. After it leaves the grinding machine, each workpiece is advanced along the transfer chute *K* to a centreless rolling unit *L*, whereby serrations are formed on the central portion by diametrically-opposed rolls, as shown diagrammatically at *l*. These serrations later serve to secure the rotor assembly. A second centreless grinding machine *M* is provided for finishing the previously-ground diameters at each end of the workpiece, also the crests of the serrations, as indicated at *m*. The last stage in the production of the rotor shaft consists of cutting a keyway at one end, and this operation is performed on a special milling unit *N*. As indicated at *n*, the workpiece is clamped between V-jaws, and the keyway is machined by a side-and-face cutter. The loading and unloading arrangements are similar to those that have been described, and from the milling unit the shafts are delivered to a work bank *P*. A bank is provided at this stage in the transfer line to provide a buffer stock in advance of the special horizontal press for fitting the rotor lamination stacks.

Lamination stacks, complete with die cast cooling fans at each end, are delivered to the horizontal press *R* from an adjacent section, and are chute fed to the operating position, to which shafts are delivered by a loading mechanism of the type already described. The shaft is thrust through the lamination assembly by a hydraulic ram at one side of the press, and its final position is controlled by a stop. The complete rotor assembly is withdrawn and deposited on the transfer chute at the front of the press, and is delivered to the special multi-tool lathe S. Here, a skimming cut is taken on the periphery of the lamination assembly, with the shaft supported between centres, and from the lathe, the rotor assembly is tranferred to the automatic dynamic balancing machine *T*. This machine provides for determining the position and magnitude of the out-of-balance mass, and for drilling a correcting hole. Finally, the rotor assembly is delivered to the unloading station *U*.

Figures have been published from which the effectiveness of the automatic rotor lines can be assessed. Before the introduction of these lines, rotor assemblies were being produced at the rate of 76,800 per year, and 3,200 assemblies were produced per worker, at a basic cost of 6·55 roubles per assembly. Now, the output of rotor assemblies is 168,100 per year, 32,000 assemblies being produced per worker at a basic cost of 2·56 roubles per assembly. An improved automatic line for rotor shafts, and a somewhat similar line for the production of a range of splined shafts for the Krasny Proletarii lathe factory, have been designed and were in the course of construction at the time of our visit, and reference will be made to these lines later in this article.

AUTOMATIC TRANSFER LINES FOR GEARS

The ENIMS institute has been engaged in the development of automatic production lines for gears, and a line for making spur gears was constructed in the institute machine building works, and has now been installed at the Krasni Proletarii factory. A general view of this line during the final stages of erection and tryout at the ENIMS plant is given in Fig. 3. It was the first automatic

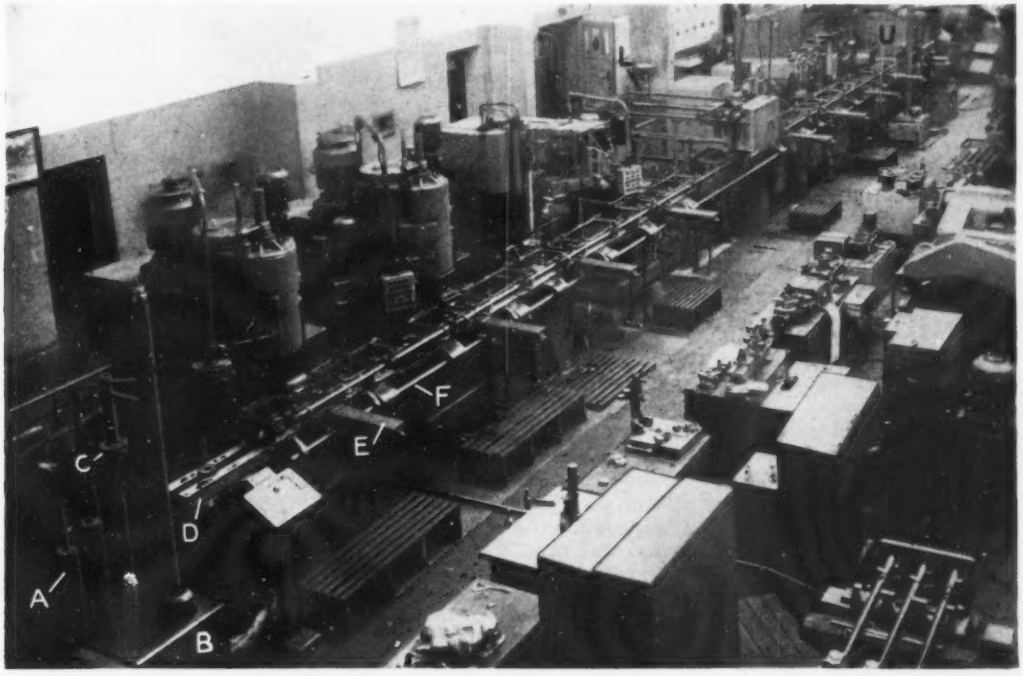


Fig. 3. This Automatic Line for the Production of Spur Gears is Seen During the Final Stages of Try-out in the Assembly Bay of ENIMS Machine Building Plant. It was the First of its Type to be Built in the U.S.S.R.

line for the production of gears to be built in the U.S.S.R., and is designed to machine 126,000 gears per year, in a range of 10 sizes, with diameters from 80 to 320 mm. (3·150 to 12·598 in.), and teeth of 1·5 to 5 module. The line is built up from universal machine tools, which are connected by a transfer conveyor, blanks being loaded automatically at one end, and gears unloaded at the other. A work-bank is installed immediately in advance of the hobbing machines provided for cutting the teeth, and two such machines have been found necessary in order to maintain an operation cycle of 1½ min. The time required to change from the production of one size of gear to another is stated to be 4 hours.

Forged blanks are loaded to an indexing carrier at the entry end of the line, where they are stacked on vertical rods, as indicated at *A*. At the side of the indexing carrier there is a mechanical transfer unit *B*, which has a vertical tubular column, housing a motor-driven screw. The screw engages a nut in the column, from which project two arms that pass through a longitudinal slot in the column. At the outer ends of the arms is fitted a tubular support for a chuck *C*. The chuck is normally positioned over one of the stacks of forgings on the indexing carrier, and the arrangement is such that the chuck can be fed downwards to engage the uppermost forging on the stack, by means of the screw, the rod of the indexing carrier passing through the tubular chuck support. When the pressure of the lower face of the chuck on the upper face of the blank reaches a pre-set value, the jaws close, and the direction of rotation of the screw is then reversed. As a result, the chuck is raised, carrying the forging clear of the stack, and when the chuck reaches the upper limit of its travel, the complete column assembly is swung through approximately 90 deg., to position the chuck and forging over the transfer ways *D*. Next, the direction of rotation of the screw is again reversed, and the chuck is lowered to deposit the forging on the ways. Then, the jaws are opened automatically, the chuck is raised, and the column is returned to its original angular setting.

The transfer ways consist of two channel-section members, with a gap between them, and the forging rests on the upper flanges, with its longer boss projecting downwards, through the gap. Above the channel members there is a reciprocating shuttle bar carrying a series of downwardly-projecting hinged plates. When the shuttle bar is moved to the left (as viewed in Fig. 3), the plates can swing upwards, so that they pass over the workpieces on the channel members, but as the bar moves in the opposite direction, the blades engage the workpieces and advance them along the channels. In front of each machine in the line, there is a housing for a horizontal ram, as at *E*, and in the under-side of each ram are cut rack teeth, which are engaged by gears on the shaft *F*, extending along the front of the transfer line. By rotation of the shaft in one direction, the ram at each machining position is advanced and fingers at the end of the ram grip the workpiece in the machine. When the shaft is rotated in the reverse direction, the workpiece is withdrawn and deposited on the transfer ways. Then, the overhead shuttle bar is actuated to remove the workpiece from the loading station, and to transfer a fresh workpiece to this position. Next, the ram is again advanced to carry the fresh workpiece from the transfer ways into the chuck, or other clamping unit on the associated machine, and, finally, the ram is withdrawn.

Fig. 4 is a diagrammatic view of the gear machining line, showing certain of the operations performed, and a typical blank is seen at *a*. The first machining stage is carried out on a vertical multi-tool lathe *G*, the operations performed being shown schematically at *g*. Tools on the upper vertical slide rough-machine the bore, form a chamfer in the bore, and face the boss. A button-type tool on a horizontal slide machines the flank of the wheel portion, and two tools on a side vertical slide machine the periphery of this portion as far as possible and form a chamfer at its junction with the flank.

From the first multi-tool lathe, the workpiece is returned to the transfer ways, along which it passes to a second machine *H*, of similar type. During this movement, the workpiece is inverted, so that in the second lathe it is gripped on the previously-machined surfaces. On the second lathe, the bore is semi-finish machined and countersunk, and the boss is faced, by tools in the overhead slide. A button tool on the horizontal slide machines the flank of the wheel portion, and the periphery of this portion is machined by a tool in a side vertical slide, to blend with the previously-machined surface, as indicated at *h*.

From the second lathe, the workpiece is transferred to the vertical broaching machine *J*, where the bore is finished to size and internal splines are cut. After the broaching stage, the blank is transferred to a third vertical multi-tool lathe *K* for final machining of the periphery and relieving one face of the wheel portion, as indicated at *k*. For these operations, the workpiece is mounted on a special driver which enters the splined bore, to ensure that the periphery and bore will be concentric. It will be observed that the turning operations are performed by button tools, and that a form tool is provided for chamfering the

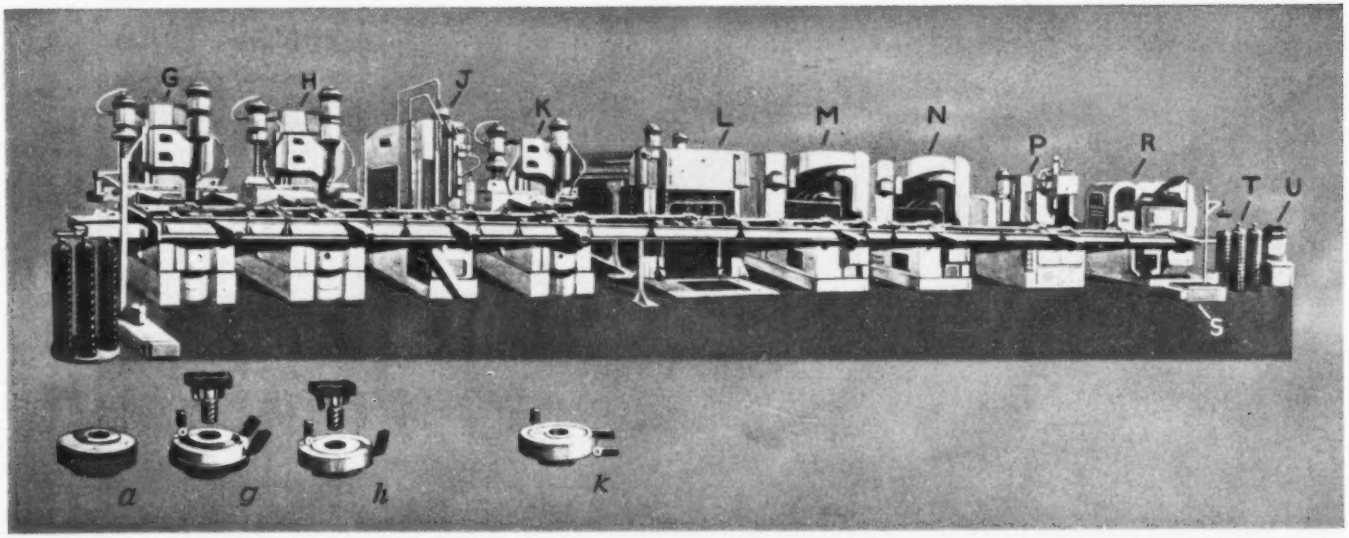


Fig. 4. Diagrammatic Layout of the Automatic Gear Machining Line, Fig. 3. Workpieces Pass, from a Loading Unit at the Left-hand End, Through Two Multi-tool Lathes, a Broaching Machine for Cutting Splines in the Bore and a Third Multi-tool Lathe, before They are Delivered to a Work Bank. From the Bank, they are Transferred to Either of Two Hobbing Machines, then to a Tooth-rounding Machine, and Finally to a Shaving Machine. A Separate Semi-automatic De-burring Unit is Installed Adjacent to the Unloading End of the Line

edge which was not broken at the second turning stage (machine *H*). In order to avoid splashing of the coolant that is employed for the cutting operations, and the scattering of chips, the working zone of each multi-tool lathe is enclosed by guards, and the front of each guard is formed by reinforced rubber flaps to permit the passage of the workpieces.

The third turning stage completes the preliminary operations on the workpieces, and when each leaves the machine *K* it is moved along the transfer ways to a position in front of the work bank *L*. This unit, also indicated in Fig. 3, extends at right-angles to the transfer ways and on its base are mounted vertical pillars, arranged in rows. Rails are supported on stanchions above these pillars, and project over the transfer ways. A carriage, which moves on the rails, incorporates a pair of cross-rails whereon a second carriage can be traversed, both carriages being coupled to endless chain loops, driven by electric motors. The second carriage supports a vertical tubular ram, with a chuck at its lower end, which can be raised and lowered by power, and the arrangement is such that the chuck can be positioned over a workpiece on the transfer ways, lowered to engage the workpiece and grip it in the jaws, raised and traversed inwards to position the piece over a vertical pillar, and lowered to load it on the pillar. Finally, the jaws are opened, to release the workpiece before the chuck is raised and returned to its original position. Control arrangements are incorporated whereby the rows of pillars, and the pillars in each row, are filled progressively, and by

reversing the sequence of operations the workpieces can be withdrawn from the bank and deposited on the transfer ways.

Workpieces are only transferred to the bank if the ways on the far side of the bank are full. Normally, they pass from the third multi-tool lathe directly to either of the two hobbing machines *M* and *N*. These machines are of a standard type, but the drive systems have been modified, it is stated, to enable tungsten carbide hobs to be used, and down-cutting is employed. Gears from both hobbing machines are delivered to a tooth-rounding machine *P*, which chamfers each tooth at one end, and thence to a shaving machine *R*, for finishing the tooth-profiles. Finally, the completed gears are returned to the transfer ways, from which they are removed by an unloading unit *S*, of similar design to the loading unit described earlier, and they are deposited on the vertical rods of an indexing carrier *T*. From the carrier, they are loaded by hand into a semi-automatic deburring machine *U*, this unit also being indicated in Fig. 3.

Figures have been made available which provide a comparison between the efficiency of the new transfer line and the non-automated method previously employed. An output of 126,000 gears of 10 sizes is achieved with both systems, and from 10 to 12 changeovers are required each month. Output per worker was 3,600 by the old method as compared with 21,000 on the new line, and the average basic cost per gear over the whole range of sizes has been reduced from 4·93 to 4·33 roubles.

The ENIMS institute is engaged in the development of other automatic production lines for gears, and a similar line to the one that has been described is now being designed, and will have provisions for hardening the gears by h.f. induction heating after they have been shaved, a lapping machine being installed for final finishing. The line for spur gears that has been described, also the rotor shaft line, suffer from a lack of flexibility, since if one machine in the line breaks down, several succeeding units must stop operation. Moreover, the movements of the loading and unloading mechanisms cannot be "overlapped" with the machining cycles, and access to the working zones of the machines is restricted by the shafts, ways and supports of the transfer mechanism.

GEAR LINE WITH "FLEXIBLE" TRANSFER SYSTEM

A machining line with improved transfer arrangements has been designed for the production of cluster spur gears, and a plan view of part of this line is shown in Fig. 5. It incorporates a hobbing machine *A* and two shaping machines *B* and *C* for cutting the teeth, also a cleaning unit *D*, and there is a work bank alongside each machine, as indicated at *E*. Between each machine and the bank at either side, there is a transfer unit, at *F* and *G*, all these units being of generally similar design.

Each transfer unit has a swinging arm, with gripper fingers at its free end. The arm of the unit on the left-hand side of a machine (for example, the unit *F*) can be moved in one direction to remove a workpiece from the bank, and then in the opposite direction to load the workpiece in the machine; the arm of the right-hand unit moves in a similar manner to remove a workpiece from the machine and transfer it to the work bank between this machine and the next. Each bank has an indexing carrier which can accommodate four stacks of workpieces, and as each stack on the loading side is exhausted (or a stack on the unloading side completed), the carrier is indexed through 90 deg. to bring a fresh stack (or an empty support) into position.

With this system, the various machines in the

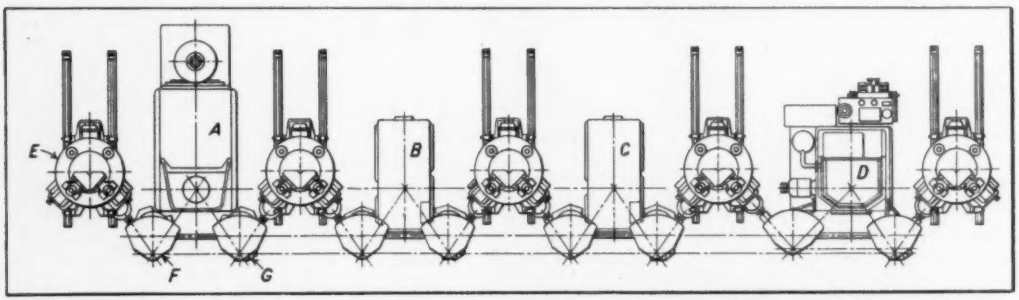


Fig. 5. Plan View of Part of a New Line for the Production of Cluster Gears. A Hobbing Machine and Two Gear Shapers are Installed for Cutting the Teeth, and Workpieces are Transferred by a "Flexible" System, with Work Banks Installed Between the Machines

Fig. 6. A General View of the Bay for the Construction of Automatic Machining Lines in the ENIMS Machine Building Plant. At the Left may be Seen a Line for the Production of Splined Shafts, and at the Right, a Line for Electric Motor Rotor Assemblies

line can be operated independently, and their working zones are completely accessible. Of even greater importance, most of the movements associated with loading and unloading can be carried out during the actual cutting cycle. Since the work banks and transfer units are of standardized designs, their cost is not excessive, and is stated to be a little higher than that of a "rigid" transfer system, as fitted to the automatic line for single spur gears.

An automatic production line incorporating the "flexible" loading and transfer system is being designed for machining spiral bevel gears, and will be installed in the Gorki motor car plant. Planned for an output of 500,000 gears per year, this line will have five independent sections as follows:—turning, boring and grinding; rough gear cutting; tooth chamfering; finish gear cutting; and stamping the finished parts. None of the machines will be required to operate at a fixed rate, and workpieces will be transferred from each machine into a bank, and from the bank into the next machine. It will be possible to introduce new machining units at any time to meet changes in component design or to increase output, and, where necessary, any of the production units could be by-passed by means of auxiliary chain conveyors.

In the machine building plant of the ENIMS institute, one bay is employed principally for erecting automatic machining lines of the types that have been described, and a general view of this bay is given in Fig. 6. As has already been intimated, two transfer lines were under construction at the time that this photograph was taken, the one at the right being an improved line for the production of electric motor rotors. The left-hand line is for machining splined shafts, in a range of 10 different sizes.

AUTOMATIC MACHINING LINE FOR SPLINED SHAFTS

The splined shaft line is similar in many respects to the line for rotor shafts that has been described. Blanks, cut from steel bar, are chute fed to the starting end of the line, and are moved along a transfer trough by dogs that project downwards from an overhead shuttle bar, until, in turn, they reach the loading position for the first machine. This unit provides for facing both ends of the blank to a predetermined length, and square with the blank axis. From the facing machine, each blank is transferred to a centring machine seen in the foreground in Fig. 6. Faced and centred blanks are delivered successively to the first of three standard Ordzonikidze copy-turning lathes. These machines are similar to those described in the second article in this series, and an Ordzonikidze lathe exhibited at the Leipzig fair was shown in MACHINERY, 92/1477—20/6/58. On the first machine of the group, indicated at *A* in Fig. 6, a series of steps is turned at one end of the blank. At the end of this stage, the workpiece is transferred to the second lathe, by way of a turn-round unit, which reverses it, end for end, in readiness for turning a series of steps at the opposite end.

A close-up view of the second lathe is given in Fig. 7, and the turn-round unit is indicated at *B*. This unit is of simple design, and consists, basically, of a length of transfer trough which can be turned through 180 deg. A workpiece is thrust into the trough by a dog on the shuttle bar during one transfer sequence, the trough is indexed, and at the next sequence the workpiece is thrust out of the indexing section of trough into the section leading to the loading station for the second copying lathe. Seen at *C* in Fig. 6 and 7, the shuttle bar extends for the whole length of the transfer line and is built up from sections of convenient length which are coupled together as may be observed at the right in Fig. 7. The bar is supported by pairs of diabolo-shaped rollers, which are mounted on brackets secured to the machine beds at intervals along the line. Simple pivoted pawls hang down from the bar, as indicated at *D*. The transfer trough is in sections, one section being seen at *E*, and each section slopes downwards from one machine to the succeeding unit, for reasons that will later be made clear.

AUTOMATIC LOADING MECHANISM

At each machine station along the line, there is an automatic loading unit, and that for the second Ordzonikidze lathe is indicated at *F*. This unit, like those for the first and third lathes, is floor mounted, and is of an improved type, which permits a shorter loading time than those on the earlier rotor-shaft line. Each unit has two hydraulically-operated transfer rams *G* and *H*, with replaceable V-section carriers at the free ends of their piston rods. The ram *G* is inclined at a slight angle from the horizontal, and, in the withdrawn position shown, its work carrier is in line with the upper end of the transfer trough *E*. Ram *H* is inclined at a greater angle, and in the withdrawn position, its carrier is aligned with the end of the transfer trough from the turn-round unit *B* (or, at other stations of the line, with the lower end of the trough from the preceding machine). When both rams are advanced, their carriers are aligned with the common axis of the headstock and tailstock spindles of the lathe. There is a rod, as at *J*, coupled to each ram, and trips on this rod engage limit

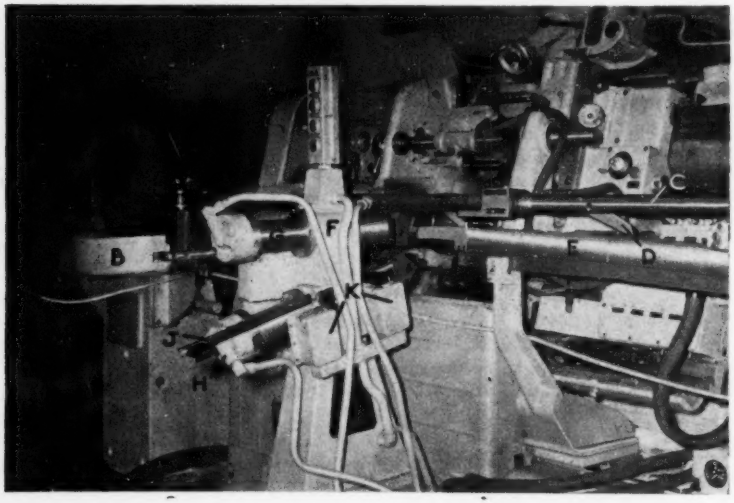


Fig. 7. Close-up View of the Second Ordzonikidze Copy-turning Lathe in the Shaft Machining Line, Showing the Automatic Loading and Unloading Mechanism and the Turn-round Unit

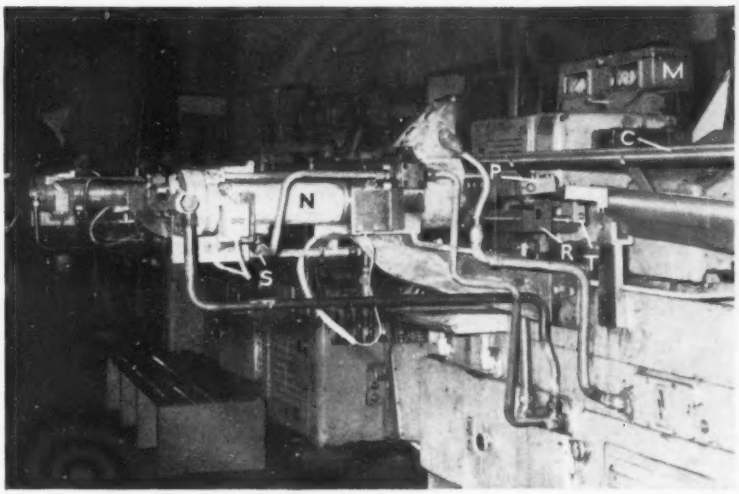


Fig. 8. The Loading and Unloading Equipment for One of the Centreless Grinding Machines in the Shaft Line, which is operated by a Single Hydraulic Cylinder with Two Pistons

switches, as indicated at *K*, to control the sequence of loading movements, through solenoid-operated valves.

At the end of the machining operation, the ram *G* is advanced and its carrier engages the turned workpiece. The hydraulically-operated tailstock quill of the machine is then withdrawn, and the spring-loaded centre in the headstock spindle thrusts the workpiece clear of the chuck jaws. Next, the ram *G* is withdrawn and carries the workpiece into alignment with the upper end of the transfer trough to the next machine. Meanwhile, a fresh workpiece has been thrust by the shuttle bar into the carrier of the ram *H*, and this ram is moved forwards, in phase with the withdrawal motion of the ram *G*, to position the fresh part between the headstock and tailstock centres of the lathe. The tailstock is advanced, pushing the fresh piece through the carrier, against the pressure of the headstock centre, until it is positioned longitudinally by a stop, between the chuck jaws. Then, these jaws are closed, and the ram *H* is withdrawn. During the next transfer stage, which is "overlapped" with the machining operations, the pawls of the shuttle bar thrust the turned workpiece through the carrier of the ram *G*, between a pair of guide plates, and into the transfer trough *E*, and deliver a fresh workpiece to the carrier of the ram *H*, in readiness for the next loading sequence.

After the first two copy-turning stages, the shafts are transferred to the third Orzonikidze machine for the final turning sequence. The loading and unloading arrangements on this unit are generally similar to those that have been described, but the workpiece is not reorientated. From the third copy-turning lathe, the shafts are fed into a work bank (*L*, Fig. 6), which holds a sufficient number of workpieces to maintain the following machines in operation for about two hours.

Four of the diameter-steps on each shaft are ground, and this work is carried out on the machines beyond the work bank *L* in Fig. 6. One step is ground on each machine, and all four are fitted with automatic feed-back size-control mechanisms. The setting unit for the control mechanism on the fourth machine may be seen at *M* in Fig. 8, where the loading equipment for the grinding machines may also be observed. This equipment differs from that installed for the Ordzonikidze lathes, but operates on similar principles. Each unit incorporates a single hydraulic cylinder, as at *N*, which has two pistons. One piston, at the left hand end of the cylinder as viewed in Fig. 8, has a solid piston rod, which passes through the tubular rod of the right-hand piston. Fitted to the free end of the solid rod is a bracket member, whereon is pivoted an arm with an adjustable yoke *P*, mounting a replaceable V-section work carrier. Tensions springs between the bracket and arm tend to pull the latter downwards. The tubular piston rod has a bracket at its free end with a rigid extension rod *R*, to which a second replaceable V-section carrier is fitted. When withdrawn, as shown, the arm and yoke *P* are lifted by the action of a cam plate secured to the carrier holder of the rod *R*, and the carriers of the yoke and rod are aligned with the outlet and delivery transfer troughs respectively.

During each loading cycle, pressure oil is supplied to the left-hand end of the cylinder, and the piston with the solid rod is urged towards the grinding machine. Once the arm with the yoke *P* is clear of the bracket on the extension *R* it is pulled downwards by the associated tension

springs. In consequence, the carrier engages the workpiece in the machine when the piston has completed its travel, which is controlled by a stop member. The tailstock centre of the machine is then withdrawn, releasing the workpiece. Next, oil is directed to an intermediate port in the cylinder by way of the pipe *S*, and the right-hand piston (with the tubular rod) is urged forwards. It will be appreciated that oil pressure is still maintained on the left-hand piston, which has the greater area. As the right-hand piston moves forwards, the extension *R* and the carrier holder fitted to it are advanced, the carrier having been charged with a fresh workpiece at the end of the preceding loading sequence. As it approaches the machine spindle-tailstock axis, the cam plate on the carrier holder contacts a roller on the arm fitter with the yoke *P*, and lifts this arm, thus raising the previously-ground workpiece to allow the next part to be positioned between the centres of the machine as the right-hand piston completes its movement. The tailstock centre of the machine is then advanced, thrusting the new workpiece against the spring-loaded headstock centre until the piece is positioned, by a stop, between the jaws of an automatic driver. Pressure oil is next applied to the extreme right-hand end of the cylinder *N*, the supply line to the intermediate port is closed by a valve, and the left-hand port is connected to exhaust. In consequence, both pistons are withdrawn simultaneously, and finally assume the positions shown. The grinding cycle is initiated, and the overhead shuttle bar *C* is traversed to the right. During this movement, the ground workpiece is thrust, between a pair of guide plates, into the transfer trough leading to the next machine, and a fresh part is pushed into the empty lower carrier from the delivery trough, to a position controlled by an adjustable stop *T*.

After each shaft has passed through the four grinding stages, it is delivered to a vertical broaching machine, whereby the splines are cut by means of a pot-type broach. From the broaching machine, the finished shafts are passed to the last unit in the line, where they are degreased and cleaned.

IMPROVED AUTOMATIC LINE FOR ELECTRIC MOTOR ROTORS

The automatic line for the production of electric motor rotors seen at the right in Fig. 6 is similar in most respects to the earlier line that has been described. In the light of experience gained from the construction and operation of the earlier line, however, the ENIMS engineers have made a number of detail improvements. In Fig. 6, the facing, centring and turning machines are at the far end, the first centreless grinding machine is indicated at *V*, and the serration rolling machine at *W*. The crests of the serrations are ground on the centreless machine *X*, and all these units are arranged in a straight line, with a common shuttle bar, which is hydraulically operated. These units form the first section of the line, and the transfer trough feeds workpieces into a work bank *Y*.

This work bank connects the first section with the second section of the line, the two sections being offset. The bank incorporates a number of sloping racks, arranged one above the other, and, under normal conditions, the rotor shafts pass down the lower-most rack to a position in line with the transfer chute of the second section. At each end of the stack of racks, there is an elevator unit, and if the lower rack of the stack should be full of workpieces each incoming workpiece is delivered by the elevator to one of the upper racks. In the event of a hold-up in the second section of the line, the racks are filled progressively, and sufficient workpieces are stored to allow the first section to continue running for one to two hours.

From the work bank, shafts pass through similar stages to those described in connection with the earlier machine, and after the rotor lamination assembly has been pressed on, a skimming cut is taken over its periphery, off the shaft centres, before the complete unit is passed to an automatic dynamic balancing and correction drilling machine. This machine is shown in Fig. 9, during the final stages of assembly in the transfer line. A set of brackets and diabolo-shaped pulleys for the shuttle bar may be seen at *A*, but the bar had not been fitted at this stage. One of the rack-and-pinion operated loading slides is indicated at *B*, and the gear spindle *C* will later be connected by a long shaft and couplings to the preceding machine in the line. In common with the loading mechanisms of the other machines that have been described, the slide *B* is set at a small angle to the horizontal, to ensure that the rotor assembly does not roll out of the V-section carrier *D*, as the slide is advanced.

When the loading slide is in the advanced position, the rotor assembly is lifted slightly and thrust forwards by dogs, out of the carrier *D* and into an intermediate position on transfer ways that pass through the balancing and correcting stations. The transfer ways are at 90 deg. to the transfer trough at the front of the machine, and pass through the machine to the rear. There are two ways which are engaged by the bearing diameters of the rotor shaft, and the rotor assembly

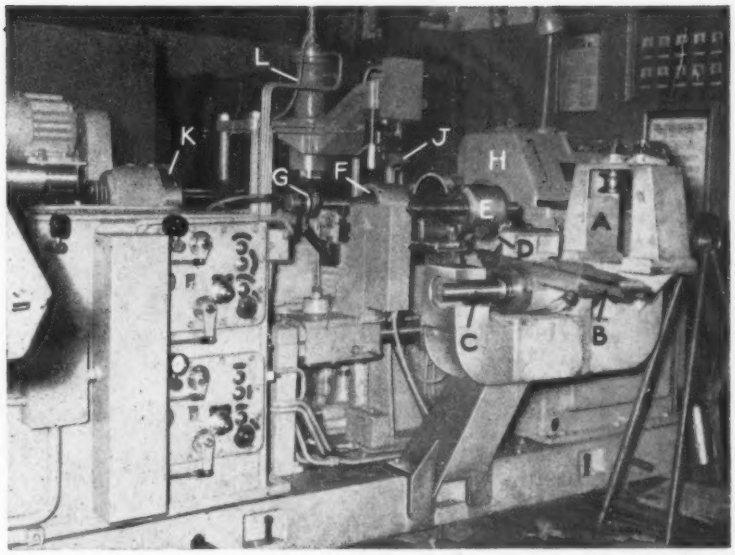


Fig. 9. The Automatic Dynamic Balancing and Correction Drilling Machine for the Rotor Line, at the Right in Fig. 6, in the Final Stages of Erection. Dummy Rotors are Seen in Position on the Machine Transfer Ways

is retained in the intermediate position by spring-loaded pawls. In Fig. 9, a dummy rotor assembly *E* may be seen in the intermediate position, and it is transferred from this position into the half-bearings at the balancing station during the next feeding cycle. A dummy rotor in this position is indicated at *F*. The rotor is moved axially by a small single-acting hydraulic cylinder *G*, and is engaged by an automatic floating coupling on the spindle of the driving head *H* of the balancing machine.

Once the rotor shaft has been coupled up, the balancing machine drive is engaged, and the position and magnitude of the out-of-balance mass is determined. Then, the drive is stopped and two steadying rollers *J* are lowered by a hydraulic cylinder to engage the outside of the rotor laminations. Next, the rotor assembly is rotated slowly to a setting controlled by the position of the out-of-balance mass, which has been "retained" by the balancing unit. The coupling is automatically disconnected, and during the next cycle of the feeding mechanism, the rotor assembly is transferred to the correction station at the rear, without disturbing its angular setting. Here, it is clamped in line with a drill head *K* by a V-section pad on the piston rod of a hydraulic ram *L*. While the next piece is being checked for balance, the drive to the drill head is engaged and the drill spindle is advanced for a distance determined by the data "retained" by the balancing unit, so that a correction hole of the required depth is produced. After the drill has been withdrawn, the clamping pad is raised and the correctly balanced rotor assembly is delivered to an unloading station at the rear during the next feeding cycle. It may be of interest to note that the ENIMS institute is developing similar equipment for balancing crankshafts automatically. With this equipment, the balance of the shaft will be checked first, the necessary data "retained" by the machine, and a suitable correction hole drilled in one of the crank webs.

The next article in this series on the Russian engineering industry will be devoted to the Moscow Ball and Roller Bearing Works, and will be published shortly in MACHINERY.

NEW IMPERMEABLE GRAPHITE—As a result of work undertaken at the Research Laboratories of the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, a new form of graphite has been developed which is completely impermeable to gases. The properties of this material will be demonstrated at the forthcoming Atoms for Peace exhibition at Geneva by means of a working experiment in which a tube of the graphite will be electrically-heated and maintained at a temperature of 600 deg. C. inside a vacuum chamber. Carbon dioxide gas at a pressure of ten atmospheres will then be introduced into the bore of the tube, and the impermeability of the material will be indicated by the fact that the pressure gauge reading remains constant. It will thus be shown that, despite the internal pressure and the external vacuum, none of the gas penetrates the heated tube. Such a material has significant advantages to offer for such applications as carbon dioxide-, water-, sodium-, and hydrogen-cooled nuclear reactors.

H

Hot-sizing Titanium and Heat-resistant Steel Parts

In the production of supersonic aircraft, and missiles for still higher speeds, various problems arise in connection with the fabrication of components from titanium and high-temperature resistant steels. A great variety of parts must be formed from sheets of these materials, and difficulty is often experienced in maintaining the required limits of accuracy on dimensions. When such components leave the hydraulic presses or drop-hammers they almost invariably have wrinkled flanges and warped surfaces. Also, it is difficult to form small corner radii.

At the works of the Los Angeles Division of North American Aviation, Inc., U.S.A., it was previously the practice to remove wrinkles from such parts, and to straighten them, by manual hammering against die-blocks similar to those on which they were formed. This bench work was tedious and occupied much time.

Some years ago, North American engineers began investigations with a view to finding a more satisfactory solution to this problem. Their efforts led to the construction of several prototype hot-sizing presses, on which patent applications are pending. Sheridan-Gray, Inc., Torrance, Calif., have been licensed to build these hot-sizing presses, and have already supplied such equipment to North American, the McDonnell Aircraft Co., St. Louis, Mo., and the Production Heat Treating Co., North Hollywood, Calif.

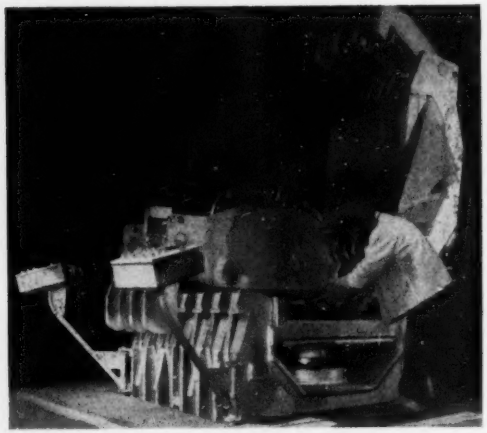


Fig. 1. These Two Hot-sizing Presses are Installed Close Together and can be Used Individually, or as One Unit for Longer Work

Two Sheridan-Gray presses, installed side by side at the North American plant so that they can be used individually or as one unit, are shown in Fig. 1. At the time the photograph was taken, a part was being hot-sized in one press, while another was being removed from the second. In addition, three prototype presses are in regular use. The workpieces handled by these hot-sizing presses range in thickness from 0·093 to 0·005 in. On many parts, dimensional tolerances of $\pm \frac{1}{32}$ in. are specified, but it is possible to produce parts to size within 0·003 in., and in some instances tolerances of this order are specified. Parts are hot-sized in less than 8 per cent of the time formerly required for bench working, and are much more accurate.

At the right in Fig. 2 are shown examples of titanium and titanium-alloy parts as they come from the forming equipment. At the left are similar parts after they have been hot-sized. Before the workpieces are passed to the hot-sizing presses, they are stress-relieved by annealing.

For the hot-sizing operation, the workpiece is placed on an electrically-heated bottom platen of the press, as shown in Fig. 3, over the form-block that was used when the part was produced on a hydraulic press or drop-hammer. At the front and rear of the workpiece and form-block there are mating die members. The bottom platen is provided with slots to receive keys that engage slots in the lower surfaces of these die members. It is thus ensured that the die members are always aligned in correct relationship with each other. This feature is especially important when using matched radius tools or dies with joggle-forming surfaces. The dies are attached to the plungers of the horizontal cylinders so that they retract with them to facilitate work removal.

With the work in place, an overhead hinged lid, to which an electrically-heated platen is attached, is lowered and locked in place by engaging toggles with heavy lugs at the front of the machine bed. In Fig. 3, the length of the work is such as to require the use of two presses. The work and dies extend across the bottom platens of both

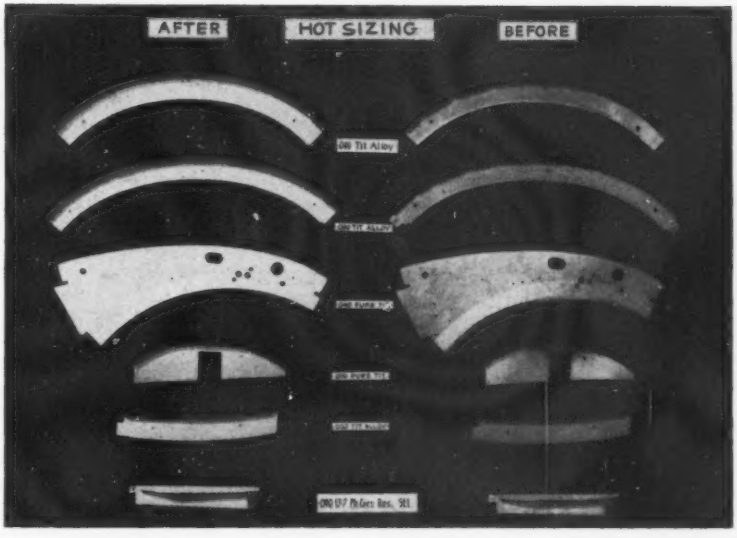


Fig. 2. Various Cold-formed Parts of Titanium and Stainless Steel are Here Shown Before and After Hot-sizing

machines and will be covered by the top platens.

Horizontal rams at the front and rear of each press are then actuated to exert a force of 75 tons per press, through sliding jaws, to force the die members against the work. Provision is made for vertical adjustment, and the lateral force can be applied at the mid-points of dies up to 6 in. high. Next, a maximum pressure of 300 tons is exerted by a vertical hydraulic cylinder beneath each of the bottom platens to force the work and dies against the upper hot platens. Pressure is applied for a predetermined length of time, which normally ranges from 5 to 10 min., depending on the gauge thickness and form of the part and the amount of metal movement required. Finally, the pressure is released and the lids are raised to enable the work to be removed.

All functions of the press, including the raising and lowering of the lid, and the movements of the vertical ram, and the sliding jaws, are controlled from a push-button panel at the front. The platens of these presses can be heated to temperatures up to 1,400 deg. F. As a rule, the machines are kept at the operating temperature for the full working week and are shut down at week-ends only. The dies are allowed to become thoroughly heated by contact with the platens before the press is put into operation. Die members are made from tool steel or Meehanite, and are machined without any allowance for spring-back or growth. There is an important saving in tool costs by reason of the fact that the dies employed for cold-forming of the workpieces can also be used for hot-sizing.

When workpieces are taken from the hot-sizing

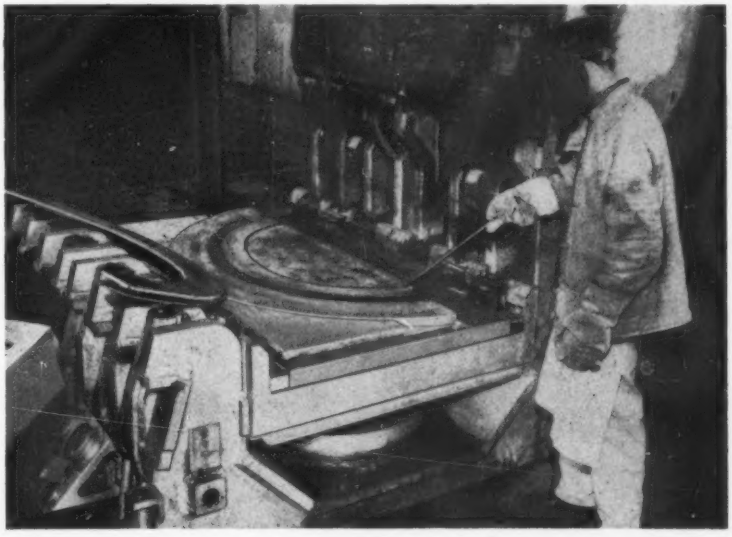


Fig. 3. A View of the Hot-sizing Presses with Both Lids raised to Show how the Two Machines can be Used Together for Long Work

presses, they are allowed to cool to room temperature without restraint. Good structural qualities are thus obtained because there are no residual stresses in the metal. Scrap loss has been reduced as a result of the adoption of this method of bringing work closely to size, and "joggle-setting" has been eliminated.

Presses of various sizes have been designed by Sheridan-Gray, Inc., from a 24- by 24-in. by 100-ton up to a 48- by 48-in. by 1,000-ton unit. Provision can be made for heating the platens to temperatures from 1,200 to 1,800 deg. F. The 1,800-deg. F. platens can be supplied with die-cushion cylinders.

A non-inflammable, hydraulic fluid is employed, and special seals are fitted to the valves and pumps to withstand the chemical action. To reduce the number of connecting lines and fittings required, a drilled steel manifold block, with flange mounted valves, is provided.

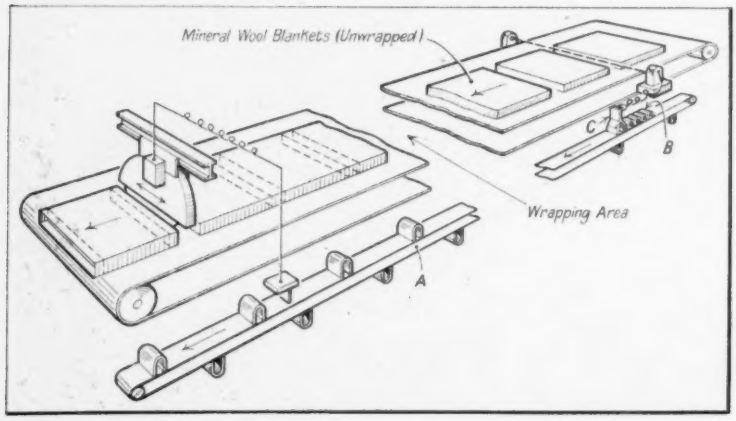
Conveyor Used as a Timing Mechanism

The Mineral Wool Insulation Co., California, U.S.A., have installed an automatic packaging plant for wrapping individual mineral wool blankets, by means of one continuous covering strip, as the blankets are traversed on a flat belt conveyor. Wrapping the blankets by this method presented a problem, however, in that once they had left the wrapping area the space between two adjacent blankets was obscured by the wrapping material, and some means had to be found of sensing the position of this gap so that the circular saw which is used to cut-off the wrapping could be fed transversely at the correct time.

The solution finally adopted involved an unusual application of a steel strip conveyor, which is arranged to run in the same direction, at the same speed, and parallel to, the packaging conveyor. This secondary conveyor, which is of Sandvik steel, 1 in. wide, is seen at *A* in the accompanying figure, and is employed to carry a number of permanent magnets, as at *B*. Arranged transversely across the packaging conveyor, there is a photo-electric cell system, which senses the gap between two adjacent blankets as they approach the wrapping area, and transmits a signal to the solenoid-operated stop *C*. This stop is employed to arrest the permanent magnets on the steel conveyor, while the latter continues to pass beneath them, and is designed in the form of an escapement so that, on receiving a signal from the photo-electric cell, it will release one magnet, but retain the remainder.

The magnet which has been released is now in line with the gap between two adjacent blankets, and, as the two conveyors are travelling at the same speed, this synchronization is maintained through the wrapping area. On leaving the latter, the blankets, which are now completely covered with a continuous wrapping, approach the transversely-mounted cutting-off saw. The feed movement of this saw head is initiated by actuation of an associated micro-switch, which is tripped as the permanent magnet passes beneath it.

With this arrangement, the wrapping material is parted accurately in the centre of the gap between two blankets, without the possibility of the saw accidentally damaging the latter. Still adhering to the steel conveyor, the magnet returns along the underside to take up a position at the rear of the group being retained by the stop *C*.



Diagrammatic view of an automatic packaging installation. A Sandvik steel conveyor carries magnets which initiate the advance of a saw for cutting the wrapping

Design Data for Flat Air Bearings when Operating Under Steady Conditions of Load

By H. L. WUNSCH,* M.Eng., A.M.I.Mech.E.

Although air bearings have been used for a variety of purposes, both in the laboratory and, to some extent, in industry, there is a definite lack of published information relating to their systematic design. It is possible to design an air bearing for a particular purpose and to make it function satisfactorily, but it is often difficult to achieve the optimum design from the standpoints of maximum stiffness, maximum load and economic air flow.

In order to provide design information for at least one form of air bearing, a fundamental investigation is at present being undertaken by M.E.R.L., East Kilbride. As a first step, tests have been carried out on a flat air bearing, of the type shown in Fig. 1 and 2, to determine the relationship between certain design parameters, such as bearing area, orifice diameter, bearing lift and load. These tests have been confined to two geometrically similar bearings of different bearing areas and the results obtained are valid only for bearings that are geometrically similar to those tested.

An analysis of the results has been made and empirical equations relating to orifice diameter, bearing area, bearing lift, load and stiffness for a supply pressure of 40 lb./sq. in., have been obtained. A design example is given at the end of this article to indicate how these results can be applied effectively in practice.

CONSTRUCTION OF EXPERIMENTAL EQUIPMENT

Two sizes of bearings have been used; the first has two equal pads each measuring $4\frac{1}{2}$ by $1\frac{1}{2}$ in. (giving an area of $13\frac{1}{2}$ sq. in.), with three air admission holes at $1\frac{1}{2}$-in. centre-distance in each pad, spaced along the centre line. The second bearing, which is geometrically similar to the first, has two pads each 3 in. by 1 in. (giving an area of 6 sq. in.), with three air admission holes in each pad at 1-in. centres.

As may be seen in Fig. 2, which is a line drawing of the equipment, the air admission holes in each bearing are drilled in detachable plugs, so that various orifice diameters can be tested, and the outlet of the orifice can be arranged so that it is either flush with the bearing surface or is set back from it by any desired amount. This set-back is accurately adjusted by means of a dial indicator, graduated in 0·0001-in. divisions, with a pointed stylus which can be placed on the orifice plug and bearing surface alternately.

Air is admitted to the bearings at one point and is distributed to the six orifices by means of internal manifolds. The bearing surfaces are ground and lapped to obtain a high degree of flatness, and the bearing floats on a base which is similarly finished. There are pegs in this base which prevent the bearing moving more than $\frac{1}{8}$ in. approximately in the horizontal plane. Loads are applied to the centre of the bearing

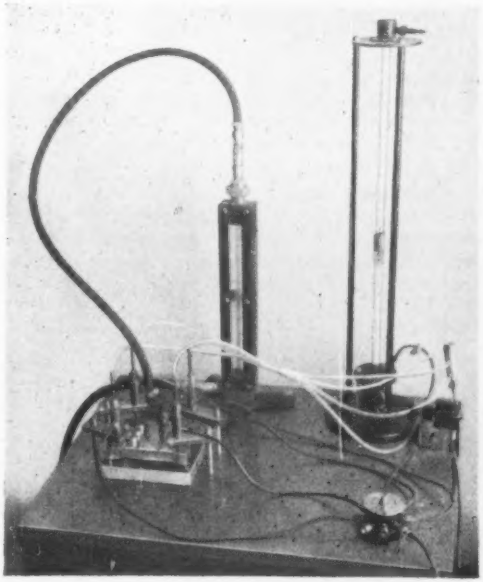


Fig. 1. General view of the experimental set-up employed for investigations into the behaviour of flat air bearings

* Department of Scientific and Industrial Research, Mechanical Engineering Research Board, Mechanisms, Metrology and Noise Control Committee.

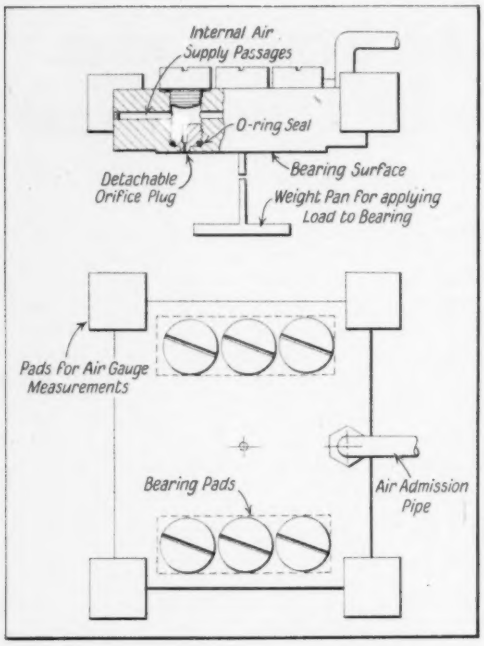


Fig. 2. Sectional and plan views of the flat air bearing of the experimental set-up, Fig. 1

by means of a wire which passes through the base and has a weight carrier at its lower end, as seen in the sectional view in Fig. 2.

In order to measure the variations in lift of the air bearing, it is provided with four flat and co-planar pads, one at each of its corners. Conventional air gauges, which have been previously adjusted and tested to give a suitable linear range and sensitivity, are supported over these pads. The lift is then indicated on a mercury column, which can be read to an accuracy of 0·01 in. mercury, equivalent to a movement of the bearing of 3×10^{-6} in.

The free air flow to the bearing is measured by a rotameter placed in the air supply line, the flow reading being accurate to about 2 per cent. of the full scale readings.

TEST PROCEDURE

In general, the test procedure consists of taking lift and flow readings for each condition of load and supply pressure. For the purpose of the lift readings, the zero position is taken as that where the bearing is in contact with the base plate, with the air supply cut off. Readings on the mercury gauge are taken at the four corners for this zero position and subsequently for the various floating positions, the differences, after conversion from inches mercury to actual movement, being taken as the lift of the bearing. The plotted results are the mean values of the four corner readings obtained with both increasing and decreasing lift.

It was found that, for any set of readings (when either the load or supply pressure was varied), the repetition of lift readings was of the order of 0·00003 in. If, for any reason, the bearing was removed from the base plate and replaced again between two readings, the repetition was about 0·00005 in. In addition, if the orifice plugs were removed and replaced between sets of readings, the repetition then became 0·00015 in. In the latter case, variations of set-back, however slight, might have been the cause of some lack of repetition.

Using the above procedure, a large number of tests was carried out and are described below. The above remarks on accuracy should be borne in mind when studying the curves in Fig. 3 to 10.

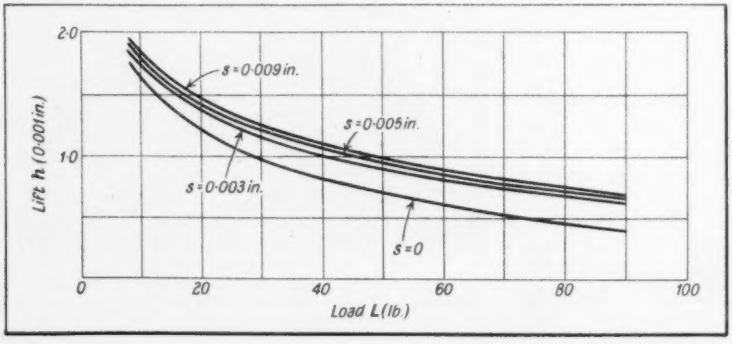


Fig. 3. Typical set of curves showing the relationship of lift to load with different set-backs of the orifice plug. The bearing area was 13½ sq. in.

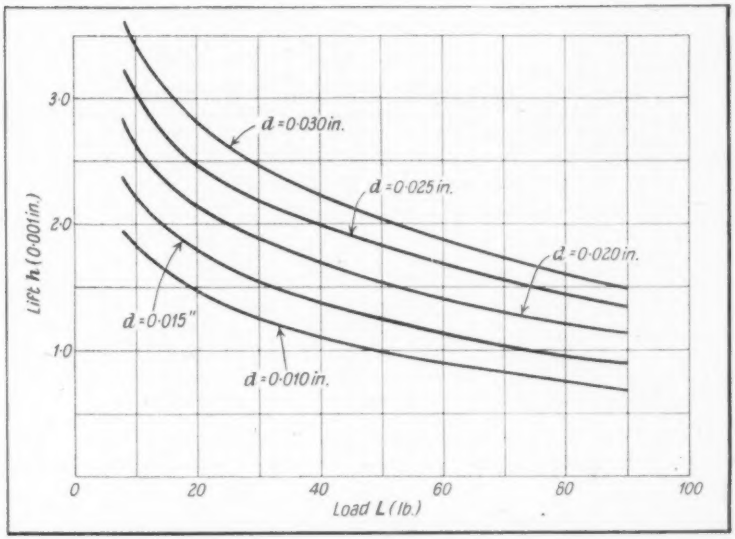


Fig. 4. These curves, for a bearing area of 13½ sq. in., show the relationship of lift to load for a specific set-back, but with five different orifice diameters

that is the values for variation in lift h should not be assessed to closer than 0·00005 in.

(1) *Effect of Variation of Orifice Diameter and Orifice Set-back.* In order to investigate the effect of changes in orifice diameter and set-back on the flow, lift, and stiffness of the air bearings, a series of tests was carried out at a supply pressure of 40 lb. per sq. in. for five different sizes of orifice, each $\frac{1}{8}$ in. long. The diameters of the orifices were 0·010, 0·015, 0·020, 0·025 and 0·030 in., and four set-backs of 0, 0·003, 0·005 and 0·009 in. were investigated, the orifice plug diameter, in each instance being $\frac{1}{8}$ in. During each test, the load was increased from 8 lb., which was the weight of the bearing itself, to a maximum of 90 lb., in steps of 5 lb. For each step, readings of flow and lift were taken with both increasing and decreasing load. A typical set of curves of lift against load for different set-backs s is shown in Fig. 3, which applies to the 13½-sq. in. bearing and an orifice diameter of 0·010 in. In Fig. 4, the results are plotted in a different manner. Here, the graphs relate to a fixed orifice set-back of 0·009 in., and for the five orifice diameters d, again on the 13½-sq. in. bearing.

In Fig. 5 are shown typical curves of air flow against load, for a fixed orifice diameter of 0·010 in., and various orifice set-backs, on the 13½-sq. in. bearing. The graphs given in Fig. 3, 4 and 5 are typical of a large number of similar graphs obtained for the two bearings, with the orifice diameters and set-backs mentioned above.

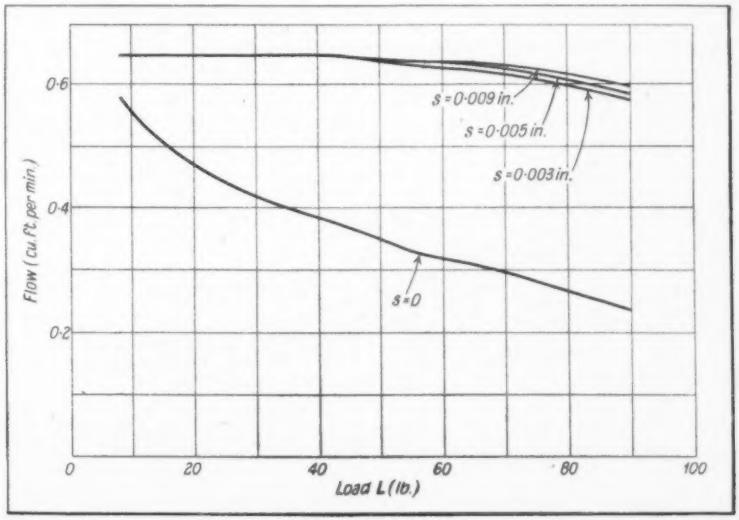


Fig. 5. Typical curves relating air flow to load for a 13½ sq. in. bearing area. A constant orifice diameter of 0·010 in. was used, but various set-backs were employed

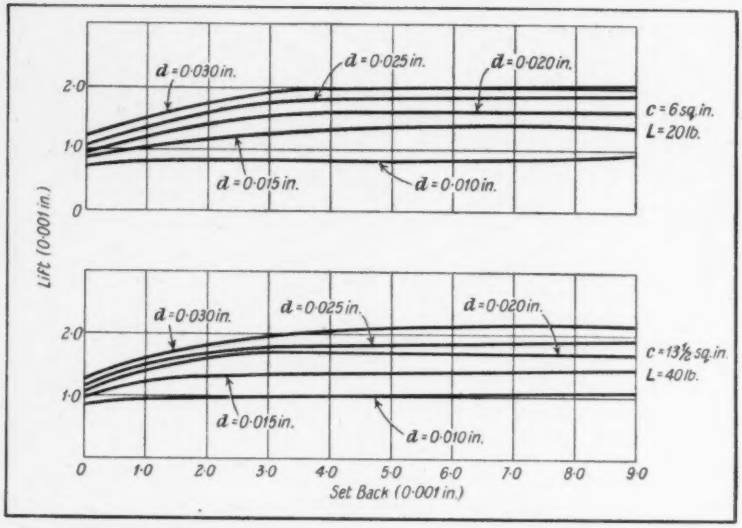


Fig. 6 (above). These curves indicate that a set-back of 0·003 in. is adequate for a bearing area of 6 sq. in. (Below) Curves showing the effect of orifice set-back on the lift characteristics of a bearing of 13½ sq. in. area, under a fixed load of 40 lb. A constant air supply pressure of 40 lb. per sq. in. was used and five different orifice diameters were employed

The effect of the orifice set-back on the lift of the bearing is clearly shown by the lower graph in Fig. 6, where the results are plotted for the 13½-sq. in. bearing under a fixed load of 40 lb., and for the five different orifice diameters (d). All the above results were obtained with an air supply pressure of 40 lb. per sq. in., and their significance will be discussed at a later stage of this article.

(2) *Effect of Variations of Supply Pressure.* In order to determine the effect of varying the air supply pressure to the bearing, tests were carried out for pressures of 20, 40, 60 and 80 lb. per sq. in., with an orifice diameter of 0·020 in. and set-backs of 0 and 0·003 in., on both bearings. A typical set of curves of lift against load for the 6-sq. in. bearing, with 0·020-in. orifice diameter and 0·003-in. orifice set-back, is shown in Fig. 7. The corresponding curves of flow against load are shown in Fig. 8.

In addition, it was thought desirable to obtain a measure of the variations of lift for small changes in supply pressure. For this purpose, further tests were carried out on the 6-sq. in. bearing, with an orifice diameter of 0·020-in. and set-backs of 0 and 0·003 in. In these tests, the applied load was held constant at 20 and 50 lb., respectively, and the supply pressure was reduced in small steps from 80 lb. per sq. in. until the air film supporting the

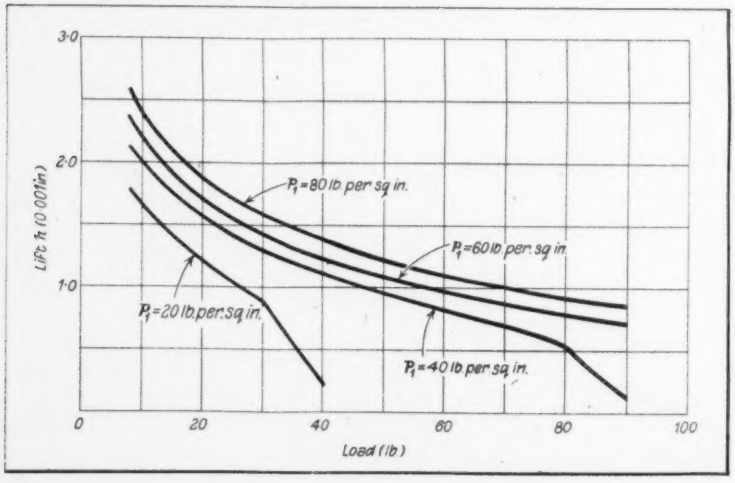


Fig. 7. A typical set of curves showing the relationship of lift to load for a bearing area of 6 sq. in., using an orifice diameter of 0·020 in. and set-back of 0·003 in.

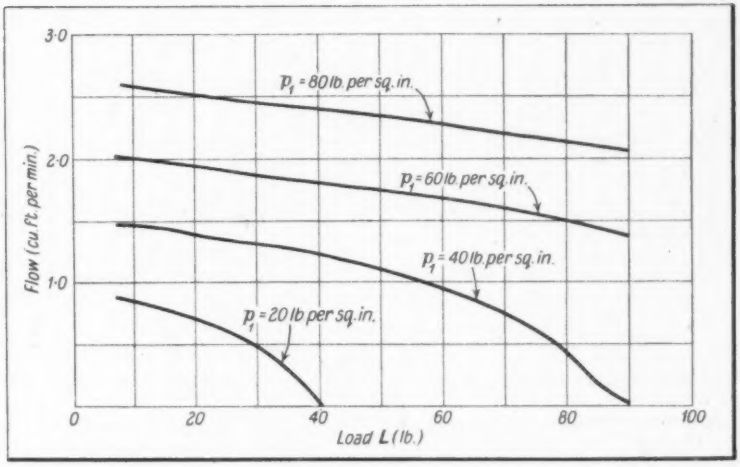


Fig. 8. The curves shown in this figure are based on those seen in Fig. 7, and show the corresponding relationship between the flow of air and the load for the 6-sq. in. bearing, when an orifice diameter of 0·020 in. and a set-back of 0·003 in. were used

bearing collapsed, readings of lift being taken at each step. A typical set of results is shown in Fig. 9, and relates to the 6-sq. in. bearing with a 0·020-in. orifice diameter, a 0·003-in. orifice set-back, and loads of 20 lb. and 50 lb.

These results are discussed in a later section. A comparison of the results in Fig. 9 with corresponding values obtained from Fig. 7 shows a reasonable agreement to within the specified accuracy of determination.

(3) *Effect of Variations in Orifice Plug Diameter.* In order to investigate the effect of varying the diameter of the orifice plug, and hence the area of the orifice set-back, some of the tests carried out under section (1) were repeated with an orifice plug diameter of $\frac{1}{4}$ in. instead of $\frac{1}{8}$ in., as was used previously.

Tests were undertaken for orifice diameters of 0·015, 0·020, 0·025 and 0·030 in., and set-backs of 0, 0·003, 0·005 and 0·009 in., all at 40-lb. per sq. in. supply pressure. A typical set of curves of lift against load for the $13\frac{1}{2}$-sq. in. bearing with an orifice diameter of 0·015 in. is shown in Fig. 10.

RESULTS

(1) From the graphs of lift against load, such as that shown in Fig. 3, it can be seen that, in general, the curves all follow a similar course until they approach the zero lift position, when they fall off at a steeper gradient to zero. The effect of orifice set-back is to increase the lift up to a certain value of set-back, beyond which no effect is noticeable. In all the tests carried out, a set-back of 0·009 in. was found to be sufficient to obtain the maximum effect for the $13\frac{1}{2}$-sq. in. bearing, while 0·003-in. set-back was adequate for the 6-sq. in. bearing, as can be seen from the upper graph in Fig. 6. This effect is also noticeable in connection with the load-bearing capacity in the 6-sq. in. bearing.

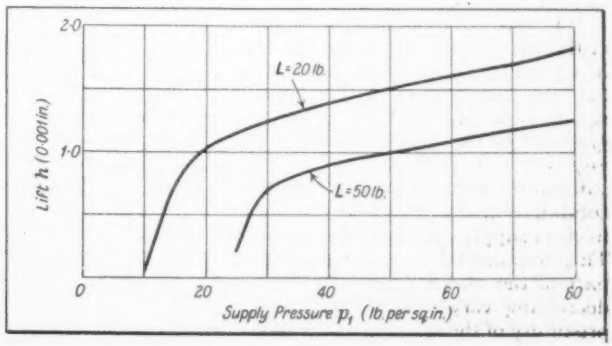


Fig. 9. Curves showing the variations of lift caused by small changes in the air supply pressure for a bearing of 6 sq. in. area. The applied load was constant and the air supply pressure was reduced in small increments from 80 lb. per sq. in.

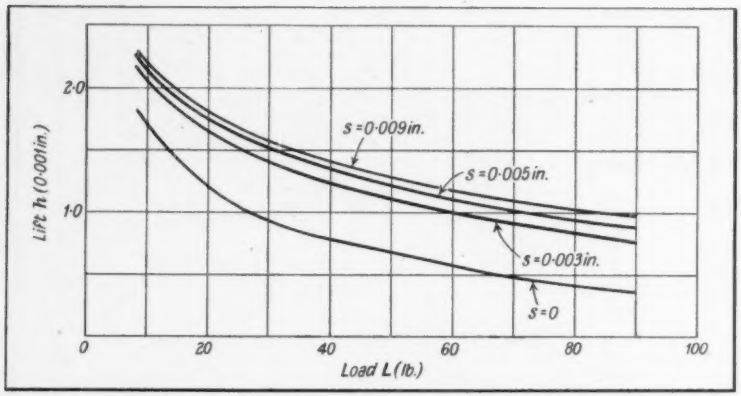


Fig. 10. Typical curves showing the effect of increasing the diameter of the orifice plug from $\frac{1}{8}$ to $\frac{1}{4}$ in.

(2) The relation of load-bearing capacity to supply pressure and bearing area can be seen on the curve for the smaller bearing in Fig. 7 (it was not possible to load the larger bearing to its full capacity). The results obtained with zero set-back (not shown) do not give the maximum load-bearing capacity, but those with a set-back of 0·003 in., as shown in Fig. 7, can be assumed to do so. The values from the curves are approximately 40 lb. for a 20-lb. per sq. in. supply pressure, and 90 lb. for a 40-lb. per sq. in. supply pressure. Therefore, if we assume that load capacity L maximum $= X \times Pc$, where P = supply pressure in lb. per sq. in. and c = bearing area in sq. in., then X is approximately 0·33, which is the value found previously for various air bearings used in the laboratory. This figure will also be found to apply in some of the other tests where the bearing was loaded to its full capacity.

(3) Apart from load capacity, one of the other important design factors in a bearing is its stiffness, that is, the load for unit deflection. This figure is, in fact, the reciprocal of the gradient of the load-lift curves at any point. It will be seen that the stiffness increases with load for any combination of orifice diameter, set-back, or supply pressure, for example. This does not take into account that part of the curve where the lift is decreasing very rapidly, due to the proximity of the bearing to the base, and where the air gap is too small for practical purposes.

Table I shows values of bearing stiffness for various orifice diameters and supply pressures. From these values, it appears that there is a general tendency for the stiffness to decrease as the orifice diameter is increased, though this tendency is not completely consistent. The effect of supply pressure is rather more obscure,

TABLE I.—Stiffness of Air Bearing (lb./in. × 10^4)

Bearing area ... = 13½ sq. in.
Set-back ... = 0·009 in.
Supply pressure ... = 40 lb. per sq. in.

Load (lb.)	Orifice Diameter (in.) 0·010	0·015	0·020	0·025	0·030
20	3·6	3·3	2·9	3·1	2·2
40	7·3	7·2	5·6	5·5	4·1
60	10·0	9·7	10·0	7·2	6·3
80	25·0	16·2	12·5	10·0	8·5

Bearing area ... = 6 sq. in.
Set-back ... = 0·009 in.
Supply pressure ... = 40 lb. per sq. in.

Load (lb.)	Orifice Diameter (in.) 0·010	0·015	0·020	0·025	0·030
20	4·5	3·3	3·0	2·7	2·2
40	8·3	8·2	5·5	4·6	4·1
60	12·5	8·2	6·4	5·5	5·5
80	10·0	4·5	5·0	4·1	4·1

Bearing area ... = 13½ sq. in.
Set-back ... = 0
Orifice diameter ... = 0·020 in.

Load (lb.)	Pressure (lb. per sq. in.) 20	40	60	80
20	3·3	2·5	2·5	2·4
40	3·8	5·6	6·3	5·5
60	—	12·5	10·0	7·1
80	—	12·5	12·5	16·5

Bearing area ... = 13½ sq. in.
Set-back ... = 0·003 in.
Orifice diameter ... = 0·020 in.

Load (lb.)	Pressure (lb. per sq. in.) 20	40	60	80
20	2·6	3·9	2·4	2·2
40	4·5	5·0	5·5	5·5
60	6·3	8·4	7·1	7·1
80	—	12·5	12·5	10·0

Bearing area ... = 6 sq. in.
Set-back ... = 0
Orifice diameter ... = 0·020 in.

Load (lb.)	Pressure (lb. per sq. in.) 20	40	60	80
20	—	2·9	3·6	3·1
40	—	7·1	8·3	6·3
60	—	—	10·0	12·5
80	—	—	—	16·6

Bearing area ... = 6 sq. in.
Set-back ... = 0·003 in.
Orifice diameter ... = 0·020 in.

Load (lb.)	Pressure (lb. per sq. in.) 20	40	60	80
20	2·8	2·9	2·5	2·7
40	—	6·3	6·3	5·5
60	—	7·1	7·1	7·1
80	—	—	12·5	20·0

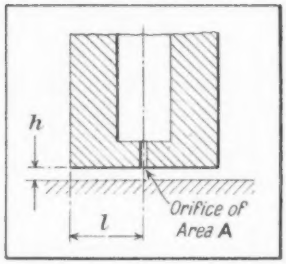


Fig. 11. Cross-sectional view of a typical plug and orifice

and, from the tabulated values, there would appear to be no general trend of stiffness variation as the supply pressure is varied. It should be pointed out, however, that, while the results dealing with orifice diameter are based on a large number of tests, those dealing with variation in supply pressure are taken from only a small group of tests and, therefore, are rather less conclusive.

(4) It is also of interest to note the effect of supply-pressure changes on the lift in a bearing under fixed load, as shown in Fig. 9, for two different loads. Apart from a rapid increase in lift at low supply pressures, the relationship between lift and supply pressure is practically linear, and the gradient is approximately the same for both loads. This result tends to bear out the statement made above that variations in supply pressure do not have a marked effect on the stiffness of the bearing, for a given set of operating conditions.

(5) Another important factor from the point of view of economy in an air bearing is the required air flow. From the results obtained for both the 6- and 13½-sq. in. bearings, the flow ranged up to 4 cu. ft. per min., the actual value depending on load, orifice diameter and orifice set-back. In all cases, the supply pressure was 40 lb. per sq. in. A typical curve of flow against load is shown in Fig. 5.

(6) It has been pointed out that two sizes of bearings, of 13½- and 6-sq. in. bearing area, were tested. For similar orifice diameters, set-backs and supply pressures, the larger bearing floated at a higher level, but the lift was less than proportional to the bearing area. It was impossible to test the full-load capacity of the larger bearing except for one test at 20 lb. per sq. in., which, however, tended to confirm the relationship found for the 6-sq. in. bearing in section 2, namely, L max. $= 0{\cdot}33\ P \times c$. It should, of course, be emphasized that the relationship only holds if the bearing is designed for optimum efficiency, that is, with a sufficiently large set-back. This statement was confirmed by testing the same bearing with equal supply pressure but without set-back.

With regard to the differences in stiffness of the two bearings, it seems possible that at the lower loads (say 20 lb.), the smaller bearing is somewhat stiffer, but as the load is increased this difference disappears and, in fact, at loads of 60 lb. or more, the smaller bearing becomes less stiff than the larger one, due to the fact that it is approaching its load limit so that the air film is beginning to collapse.

(7) As mentioned previously, some tests were carried out on the larger bearing using a ¼-in. diameter orifice plug, so that the area of set-back was quadrupled. This larger bearing appeared to have no appreciable effect on lift or stiffness, as shown in Fig. 10, but as it was impossible to test this bearing to its full-load capacity, it could not be determined whether the increase in plug size had any effect on the load capacity.

(8) Summarizing these observations, it appears

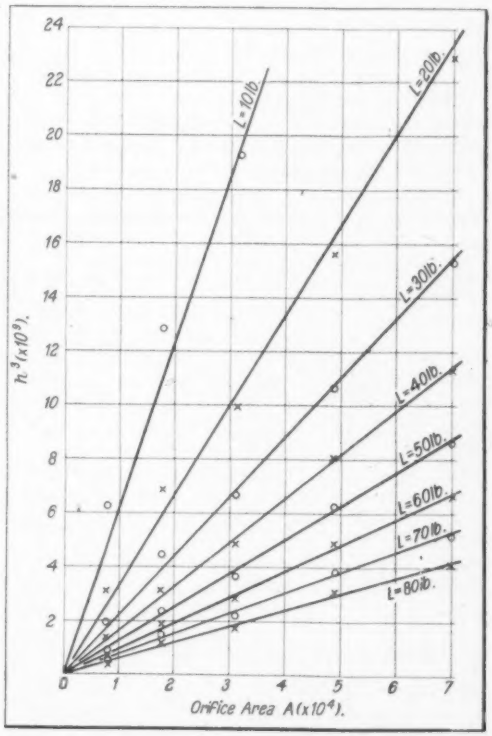


Fig. 12. The curves here shown were plotted from the experimental results in order to check the equation relating to mass flow through a small rectangular gap

that the load-bearing capacity is not affected to any appreciable degree by orifice diameter, but that it is necessary to have an adequate orifice set-back to obtain a maximum load capacity. If this condition is maintained, the load-bearing capacity is affected only by bearing area and supply pressure, to both of which it seems to be related linearly. The bearing stiffness, on the other hand, is independent of orifice set-back or supply pressure for a given load, but depends on orifice diameter, being a maximum with a minimum plug diameter. The effect of change in bearing area on stiffness seems to be slight, and depends on load.

EVALUATION OF RESULTS

A cross-sectional view of a typical plug and orifice is given in Fig. 11, where A = orifice area; h = escapement gap; and L = one half the width of the bearing. It has been suggested[1] that the mass flow through an orifice is given by an equation of the form;

$$G_1 = A f_1 (p_1 p_2)$$

or if p_1 = supply pressure = constant

then, $G_1 = A f_2 (p_2)$

where G_1 = mass flow through the orifice; p_2 = pressure at the orifice exit; p_1 = supply pressure in lb. per sq. in. absolute.

Similarly, it has been demonstrated experimentally[2] that the mass flow through a small rectangular gap between two parallel plates is given by an equation;

$$G_2 = h^3 f_3 (p_2 p_3)$$

or, if p_3 = atmospheric pressure (or pressure at exit from gap) = constant

$$G_2 = h^3 f_4 (p_2).$$

where G_2 = mass flow through air gap.

For steady flow conditions, $G_1 = G_2$

therefore, $A f_2 (p_2) = h^3 f_4 (p_2)$

or $h^3/A = f_5 (p_2)$ .....(1)

If we assume that the mean effective pressure under the bearing $= f_6 (p_2)$ then the load L carried by the bearing $= c f_6 (p_2)$ (where c = the bearing area)

and hence $p_2 = f_7 (L/c)$ .....(2)

Therefore, equating (1) and (2)—

$$h^3/A = f_8 (L/c) \quad \text{.....(3)}$$

In order to check this expression from the experimental results, h^3 was plotted against A for various values of load L and for both bearing areas c. A typical set of results obtained is shown in Fig. 12, which was plotted for the 13½-sq. in. bearing, with a supply pressure of 40 lb. per sq. in., a set-back of 0·009 in. and values of load from 10 to 80 lb. Similar sets of results were obtained for set-backs of 0·009 in., 0·003 in. and 0, on both bearings. In spite of scatter in some of the graphs, it was thought that, for any given value of L/c, a linear relationship existed between A and h^3. By drawing the best straight line through each set of values it was, therefore, possible to obtain unique values of h^3/A for each value of L/c.

By plotting these values of h^3/A against L/c for any given set-back, it was found that the curves so obtained approximated to a rectangular hyperbola. It was decided, therefore, to plot h^3/A against c/L in order to obtain a straight line for all values of L and c. This was achieved for practical values of c/L (up

1 E. Ower. The Measurement of Airflow, Chapter VI.
2 G. L. Shires. Viscid Flow of Air in a Narrow Slot. N.G.T.E. Memorandum M46 (1949).

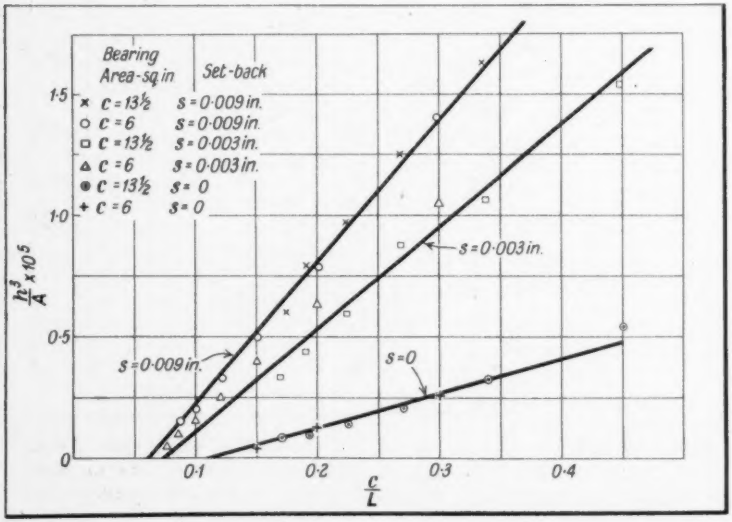


Fig. 13. Curves relating mass flow values to load and bearing area for different amounts of set-back but with a constant air supply pressure of 40 lb. per sq. in.

to 0·4), as can be seen in Fig. 13. The three lines shown here are for values of set-back of 0, 0·003 in. and 0·009 in., and for a supply pressure of 40 lb. per sq. in.

The equations for these straight lines were determined from the graphs and are:—

For $S = 0{\cdot}009$ in.,

$h^3/A = (5{\cdot}88\ c/L - 0{\cdot}38)10^{-5}$

$$\text{or } A = \frac{10^5\ h^3}{5{\cdot}88\ c/L - 0{\cdot}38} \quad \ldots\ldots\ldots(4)$$

For $S = 0{\cdot}003$ in., $h^3/A = (3{\cdot}5\ c/L - 0{\cdot}26)10^{-5}$

$$\text{or } A = \frac{10^5\ h^3}{3{\cdot}5\ c/L - 0{\cdot}26} \quad \ldots\ldots\ldots(5)$$

For $S = O$ $h^3/A = (1{\cdot}4\ c/L - 0{\cdot}16)10^{-5}$

$$\text{or } A = \frac{10^5\ h^3}{1{\cdot}4\ c/L - 0{\cdot}16} \quad \ldots\ldots\ldots(6)$$

These results were then checked against experimental values by postulating values of h, c and L and comparing the resulting calculated orifice diameter with the actual, as shown in Table 2.

From the table it can be seen that with one exception (where the experimental value does not seem to be in the correct relationship to the other experimental values) the agreement is satisfactory, bearing in mind that, in general, the value of actual orifice diameter would only be known to an accuracy of approximately 5 per cent, or even, in the case of the smaller orifices, to approximately 10 per cent.

To find the stiffness of the bearing under various conditions, the procedure is as follows:—

In general, $h^3/A = 10^{-5}\ (K_1\ c/L - K_2)$

$$L = \frac{K_1\ c}{(10^5\ h^3/A) + K_2}$$

$$\text{Stiffness} = dL/dh$$

$$= -K_1\ c(K_2 + 10^5 h^3/A)^{-2} \times 3 \times 10^5 h^2/A$$

$$= \frac{-3 \times 10^5\ K_1\ ch^2}{A(K_2 + 10^5 h^3/A)^2}$$

$$= \frac{-3 \times 10^5\ K_1\ ch^2}{A(K_1\ c/L)^2}$$

But $h^2 = [10^{-5}\ A(K_1\ c/L - K_2)]^{2/3}$

therefore $dL/dh = \dfrac{-3 \times 10^{5/3}\ L^2}{K_1\ cA^{1/3}}\ (K_1 c/L - K_2)^{2/3}$

when $S = 0{\cdot}009$ in., then d/Ldh

$$-24\ \frac{L^2}{cA^{1/3}}\ (5{\cdot}88\ c/L - 0{\cdot}38)^{2/3} \quad \ldots\ldots\ldots(7)$$

when $S = 0{\cdot}003$ in., then $dL/dh =$

$$-40\ \frac{L^2}{cA^{1/3}}\ (3{\cdot}5\ c/L - 0{\cdot}26)^{2/3} \quad \ldots\ldots\ldots(8)$$

when $S = 0$, then $dL/dh =$

$$-100\ \frac{L^2}{cA^{1/3}}\ (1{\cdot}4\ c/L - 0{\cdot}16)^{2/3} \quad \ldots\ldots\ldots(9)$$

The above results indicate that the stiffness is inversely proportional to the cube root of A, and is related to c and L as shown.

In Fig. 14, load L is plotted against lift h for the 13½-sq. in. bearing, at 40 lb. per sq. in. supply pressure, 0·020-in. orifice diameter, and 0·009-in. set-back. The values for the curve are obtained from the empirical formula and agree closely with the practical values obtained. It appears from this curve that the stiffness is approximately constant from about 0·5 to 0·9 of the maximum load. Since the practical tests on the 13½-sq. in. bearing only reached 0·5 maximum load, this relationship is not apparent from the practical curves for this bearing, but it is confirmed on the curves for the 6-sq. in. bearing, which was loaded to almost the maximum as shown in Fig. 7.

TABLE 2

Comparison of calculated orifice diameters with actual orifice diameters for various bearing areas, set-backs, lifts, and loads

Bearing area c (sq. in.)	Set-back S (in.)	Lift h (in.)	Load L (lb.)	A (sq. in.) Calculated	Orifice Diameter Calculated (in.)	Orifice Diameter Actual (in.)
13·5	0·009	$1{\cdot}46 \times 10^{-5}$	40	$1{\cdot}94 \times 10^{-4}$	0·0157	0·015
13·5	0·009	$0{\cdot}75 \times 10^{-5}$	80	$0{\cdot}99 \times 10^{-4}$	0·0112	0·010
13·5	0·003	$1{\cdot}69 \times 10^{-5}$	40	$5{\cdot}25 \times 10^{-4}$	0·0258	0·025
13·5	0	$0{\cdot}82 \times 10^{-5}$	50	$2{\cdot}54 \times 10^{-4}$	0·0180	0·020
13·5	0	$0{\cdot}45 \times 10^{-5}$	80	$1{\cdot}19 \times 10^{-4}$	0·0122	0·010
13·5	0·003	$1{\cdot}82 \times 10^{-5}$	40	$6{\cdot}55 \times 10^{-4}$	0·0290	0·030
6	0·009	$1{\cdot}22 \times 10^{-5}$	50	$5{\cdot}59 \times 10^{-4}$	0·0266	0·025
6	0·009	$0{\cdot}59 \times 10^{-5}$	80	$3{\cdot}31 \times 10^{-4}$	0·0205	0·020
6	0·003	$0{\cdot}81 \times 10^{-5}$	60	$5{\cdot}90 \times 10^{-4}$	0·0274	0·020
6	0	$0{\cdot}85 \times 10^{-5}$	20	$2{\cdot}36 \times 10^{-4}$	0·0170	0·015

CONCLUSIONS

The empirical relationships for stiffness and lift given above are valid for the two sizes of bearing tested, provided that:—

(*a*) $\dfrac{l}{a} = \frac{1}{2}$, that is for geometrically similar bearings; (where a = the length of the bearing)

(*b*) the bearings have the same distribution of orifices as the bearings tested, that is three orifices distributed so as to give $\dfrac{l}{a} = \frac{1}{2}$;

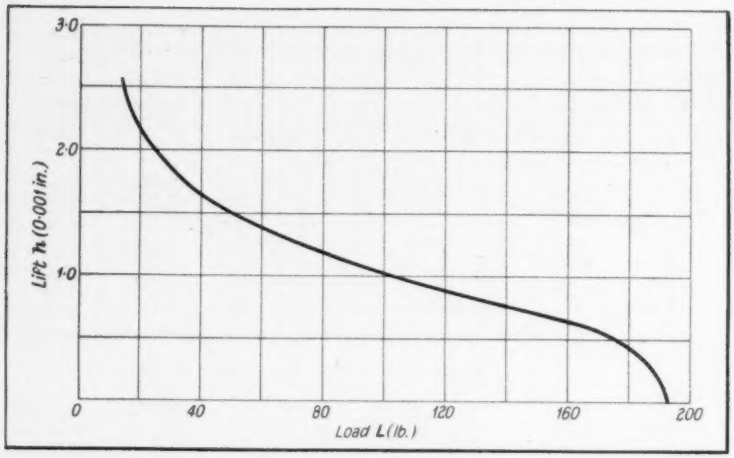


Fig. 14. In these curves, load is plotted against lift for a bearing area of 13½ sq. in., an air supply pressure of 40 lb. per sq. in., an orifice diameter of 0·020 in., and a set-back of 0·009 in.

(*c*) the supply pressure equals 40-lb. per sq. in. gauge;

(*d*) the mean effective pressure is greater than 2·5 lb. per sq. in. (that is, $c/L < 0{\cdot}4$).

It will be appreciated that the above work applies to steady conditions of loading. The effect of dynamic loading is being investigated together with the application of the above results to cylindrical bearings.

TYPICAL DESIGN EXAMPLE USING THE RESULTS OBTAINED

It is required to design an air bearing to support a sliding table weighing 500 lb., an air supply pressure of 40 lb. per sq. in. being available. The bearing is to be designed for maximum stiffness and minimum air consumption. For convenience of manufacture, orifice diameters of 0·020 in. are chosen. The condition of minimum air consumption necessitates a zero value of setback (from Fig. 5 and similar flow curves not published here). For a condition of maximum stiffness, the working load requires to be between 0·5 and 0·9 of the ultimate load (see Fig. 14). Using a working load value of 0·6, the calculated ultimate load is 830 lb.

Using equation (6) for an orifice setback of zero, it can be seen that for the condition of ultimate load ($h = 0$)

$$c/L = \frac{0{\cdot}16}{1{\cdot}4} \text{ for a supply pressure of 40 lb. per sq. in.}$$

Therefore the required bearing area c

$$= \frac{0{\cdot}16}{1{\cdot}4} \times 830 = 94{\cdot}9 \text{ sq. in. (approximately)}$$

With a bearing width of 1½ in. (as in the larger test bearing), a total length of bearing of approximately 63 in. is required, which can be designed as two pads 31½ by 1½ in. each. In order to use the same orifice distribution as in the bearing tested, each pad should have 21 orifices, 1½ in. apart and ¾ in. from each end of the pad.

Using this design, the value of lift h under the working load of 500 lb. is given by:

$$h^3 \times 10^5 = A\,(1{\cdot}4^c/L - 0{\cdot}16)$$

where $c = 94{\cdot}5$ sq. in.

$L = 500$ lb.

$A = 3{\cdot}14 \times 10^{-4}$ sq. in. (for an orifice diameter of 0·020 in.).

Whence $h \simeq 0{\cdot}0007$ in., which is a suitable bearing clearance for bearing pads manufactured to normal workshop tolerances.

The stiffness of the bearing to small changes of load is obtained from equation (9).

$$\frac{dL}{dh} = -100\,\frac{L^2}{cA^{\frac{1}{2}}}\,(1{\cdot}4\,c/L - 0{\cdot}16)^{\frac{1}{2}}$$

where $L = 500$; $c = 94{\cdot}5$; $A = 3{\cdot}14 \times 10^{-4}$.

Whence, $\dfrac{dL}{dh} \simeq 860{,}000$ lb./in.

A bearing has been designed and manufactured to the above specification, and tests, which were carried out gave the following results. The bearing was loaded in steps of 50 lb. up to a total load of 750 lb. The lift was measured for each load value, and the relationship between lift and load between loads of 500 lb. (the weight of the bearing itself) and 750 lb., was found to be linear, with a stiffness of 885,000 lb./in., which agrees closely with the calculated value. The lift of the unloaded bearing (that is, at 500 lb. load) was found to be 0·00055 in. and the small difference between this figure and the calculated value of 0·0007 in. is probably due to lack of flatness in the bearing pads giving a false zero lift value.

ACKNOWLEDGMENTS

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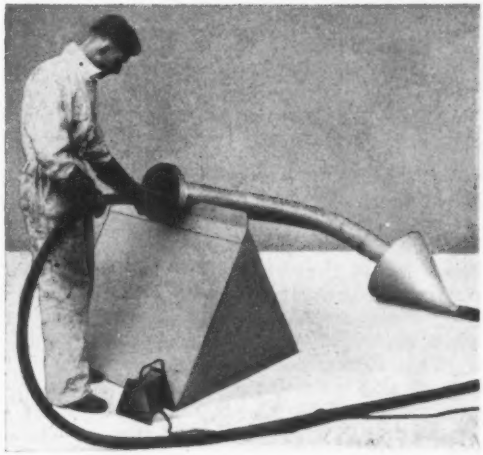
Vacu-Blast Dustless Shot Blasting Equipment for Cleaning Tubes

The range of applications for the dustless shot blasting machines made by Vacu-Blast, Ltd., Bath Road, Slough, Bucks, has recently been extended to include the cleaning of tube bores, and a patent has been granted for the technique and equipment developed for this purpose.

Reference has already been made in MACHINERY to the Vacu-Blast machines, and it may be recalled that abrasive is delivered to the blast gun by compressed air through a flexible hose, and spent shot and debris are passed to a reclaiming unit by way of a second hose attached to the gun. For tube cleaning, the hose through which the spent shot and debris is passed, is connected to a rubber-lined cone, in which one end of the tube is inserted, as shown in the illustration. The nozzle of the blast gun is applied to the other end of the tube, which may range in diameter from ½ to 2 in., and a closed circuit is thus provided.

Since the cross-sectional area of the tube should be at least as large as that of the nozzle in the blast gun, to avoid back pressure in the system, several tubes of the smaller diameters, down to ⅜ in., are arranged in a group and cleaned simultaneously. For example, seven ⅜-in. bore tubes are handled in this way when a nozzle with a $\frac{5}{16}$-in. bore is employed. An adapter of simple design is provided which will take the group of tubes and the blast gun so that escape of abrasive is prevented.

For cleaning tubes with diameters larger than 2 in., the blast gun is usually passed through the bore for the full length, and abrasive delivery is then started by a foot-operated switch. During the actual cleaning operation, the gun is drawn slowly through the bore towards the operator. Tubes from 3 to 8 in. diameter are usually cleaned with the aid of the firm's "super-sonic" nozzle, whereby the stream of abrasive is directed parallel with the bore. To ensure complete recovery of all spent abrasive and debris, tubes with bores larger than 4 in. diameter are inclined at an angle of 45 deg. In tubes which have been packed with sand and heated for a bending operation, there is often a considerable amount of heated sand and scale at the inner radii of the bends. Removal of such sand and scale is carried out by means of a nozzle which causes the abrasive to be directed at right angles to the tube surface.



Set-up for Cleaning the Bore of a Tube with Vacu-Blast Dustless Shot Blasting Equipment

A spider is usually employed for centralizing the blast gun, when tubes with bores larger than 8 in. diameter are to be cleaned. A rotary head attachment has been developed for use when straight tubes with bores from 10 to 24 in. diameter are to be cleaned. This attachment comprises two blast nozzles, which are rotated by an air motor, and the assembly is mounted on a carriage so that it can readily be passed through the bore of the tube.

It is stated that when the Vacu-Blast Major shot blasting machine with a $\frac{5}{16}$-in. diameter nozzle is employed, exceptionally tenacious scale can be removed from tubing of heat-treated alloy steel at the rate of 40 sq. ft. per hour, and that for mild steel piping, the cleaning rates may be as high as 250 sq. ft. per hour. When the Vacu-Blast Senior shot blasting machine, with a $\frac{7}{16}$-in. diameter nozzle, is used, increased cleaning rates can be obtained.

THE NUMBER OF PEDAL CYCLES which were produced and delivered in the second quarter of this year reached a total of 516,000, of which 345,000 were exported. In the second quarter of the previous year, the corresponding figures were 626,000 and 409,000, respectively.

Preparation of Wires for Elaborate Electronic Circuits

By A. G. DIMOND

To facilitate the wiring of the complicated electronic circuits for Firebee jet-propelled target aircraft, special equipment and arrangements are employed at the works of the Torrance Division, Ryan Aeronautical Co., U.S.A. Originally much time was occupied in searching for the various wires at the assembly station. A wire numbering machine is now employed in conjunction with an electronically-controlled wire cutter, as shown in Fig. 1. The wires are cut and numbered by this equipment in the order in which they will be attached to the plugs, and the various lengths are subsequently kept separate by means of comb racks of the form shown in Fig. 2.

Before the wires are transferred to the assembly stations, the loaded racks are passed to the stripping and tinning installation, also seen in Fig. 2. Here, the operator removes the insulation from the wire ends with a pneumatic stripper, and tins the exposed ends in a pot of solder. Subsequently, the prepared wires are placed in vertical frames, still in the order in which they will be used. The frames, together with trays containing other components and sub-assemblies, are carried in racks between the assembly stations, which are arranged back to back. With this system, the assembly operator has only to reach behind her to pull the wires from the frame in the order in which they are required.

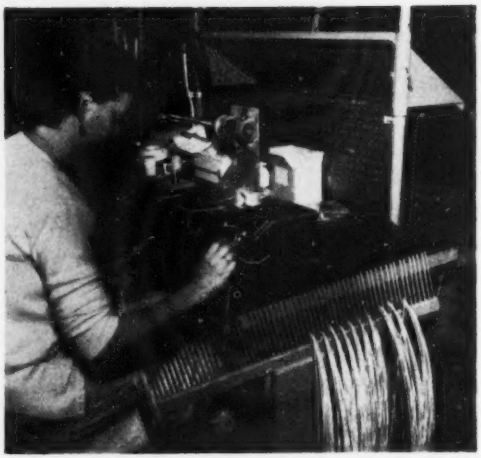


Fig. 2. Wires of different lengths are kept separate in a comb rack. At this station the ends are stripped and tinned

After single plugs have been wired, they are taken to an assembly board, which determines the correct layout of the complete harness. This board is also provided with holding pins and plug connections so that a test lamp can be used to check for circuit continuity.

When a harness has been assembled, an insulating compound is forced into the hollow backs of the plugs around the pin connectors. This compound, which is purchased in a frozen condition and kept hard in a deep freeze, softens when it is allowed to come to room temperature. An air gun, operating at 90 lb. per sq. in. pressure, is employed to force the compound into the plug. For curing the compound, the harness is placed on a special board or frame, which is then raised into a chamber equipped with infrared lamps.

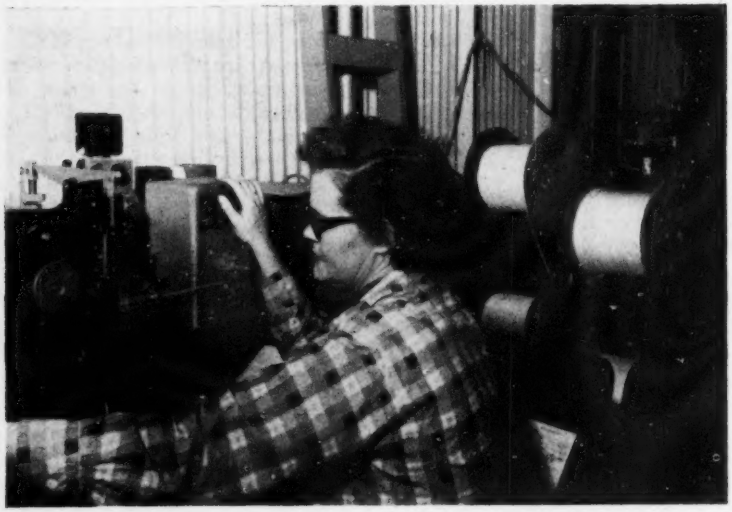


Fig. 1. Wire numbering and electronically-controlled cutting installation

Improved Facilities for the Production of Castings by the Mercast Process

The New Crawley Works of Sankey-Telcon, Ltd.

The advantages afforded by the Mercast process of precision investment casting for the production of a variety of intricate components, notably wave guides and certain gas turbine parts, were discussed in articles in MACHINERY, 90/736—5/4/57 and 90/813—12/4/57, and examples of castings made by this method, both in this country and the U.S.A., were considered. As was then mentioned, the only licensees for the process in this country are Sankey-Telcon, Ltd., a company of the G.K.N. Group, but jointly owned by The Telegraph Construction & Maintenance Co., Ltd.

Since these articles were published, a new factory has been brought into operation at Telcon Works, Manor Royal, Crawley, Sussex, to provide improved facilities for the production of castings by the Mercast process. In the new factory, the pattern- and mould-making shop, the foundry and finishing department, and the toolroom, are housed in a single building, which has an area of 5,000 sq. ft. In addition, there is a department for the radiographic examination of castings, a drawing office, and general offices. A.I.D. chemical analysis and associated facilities are provided by The Telegraph Construction & Maintenance Co., Ltd., on whose premises the factory has been built.

The pattern- and mould-making shop houses two thermally-insulated tanks, as shown in Fig. 1. In the tank seen in the foreground, pouring of mercury into metal moulds is carried out, followed by freezing in a refrigerated bath of acetone, for the preparation of patterns.

This freezing tank measures 11 ft. long by 4 ft. 6 in. wide by 4 ft. 9 in. deep, and is maintained at a temperature of −63 to −67 deg. C. Upon completion of the freezing stage, the pattern, now in a solid state, is removed from the mould, and transferred to the second tank, where it is invested by dipping in a zircon-base ceramic slurry. The investment tank is maintained at a temperature of −60 to −63 deg. C., and measures 6 ft. long by 4 ft. 6 in. wide by 4 ft. deep. When the shell has been built up to the required thickness, and has been dried, the mould is removed from the tank and passed to a booth, where the temperature rises and the mercury melts out.

As was explained in one of the earlier articles, melting is initiated by directing a stream of mercury on to the surface of the frozen metal in the mould. As melting-out proceeds, the mercury falls through a metal grille in the floor of the booth, to a trough below, where it is covered by a layer of acetone which suppresses the formation of vapour. The mercury is then reclaimed, to be

Fig. 1. The freezing and investment tanks for making shell moulds for Mercastings

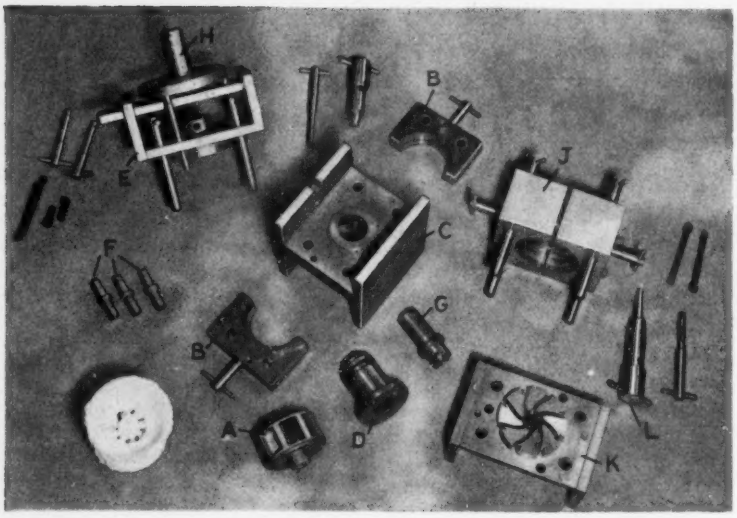


Fig. 2. A mould for producing a frozen mercury pattern of the rotor breather seen at *A* is here shown dismantled

used again for the production of other patterns.

When frozen patterns have been removed and transferred to the investment tank, the metal moulds and associated core pieces are passed to acetone baths, which are maintained at a room temperature by a steam heating coil. In this way, the temperature of each set of mould components is raised so that they may be readily assembled for preparing the next pattern.

To reduce fire risks, lighting and electrical equipment in the pattern- and mould-making shop is of flame-proof design, and compressed air motors are employed for certain stirrers and hoists. For the same reason, the mechanical refrigeration plant for the freezing and investment tanks is housed in a separate, totally-enclosed room. The slurry mixing unit incorporates two stirrers driven by flame-proof electric motors, and since it is brought into operation intermittently it is cooled by solid CO_2.

A ventilating system is installed for removing acetone and mercury vapour.

In the foundry, there is an infra-red cabinet for thoroughly drying green moulds, which are subsequently fired in a trolley hearth electric furnace. Rocking hearth, indirect arc furnaces, and high-frequency spark gap furnaces of 20-lb. capacity are installed for melting high alloy steels. Aluminium alloys are melted in a 50-lb. capacity electric resistance furnace of the bale-out type, and there is a 100-lb. capacity gas-fired tilting furnace for copper-base alloys. In addition, a 56-lb. vacuum furnace is installed for both melting and casting duties.

Since castings produced by the Mercast process are usually required to be held to close dimensional tolerances, it is necessary for metal moulds to be produced to a high degree of accuracy. Such a mould is usually made in several pieces, which are dismantled to permit of removal of the frozen pattern, and to prevent leakage of mercury during the pouring stage, clearances between mating surfaces of adjacent parts should not exceed 0·0005 in. Equipment installed in the toolroom, where the production of moulds is undertaken, includes a Hauser type 3 S.M. jig grinder, and a Cincinnati type 8-18 vertical-spindle tool and die milling machine which incorporates hydraulically-operated copying equipment.

SOME EXAMPLES OF MERCASTINGS

A good example of the type of built-up metal mould that is sometimes required in connection with the production of Mercastings, is shown dismantled in Fig. 2. This mould is for making a frozen mercury pattern of the 3-in. diameter rotor breather for a gas turbine, indicated at *A*. The component incorporates 8 vanes, 1·2 in. long which have return lips at their outer ends. The pattern is made in two halves, and when the joint faces are pressed into contact with each other, the high rate of self diffusion of the frozen mercury causes them to weld together to form the complete pattern—a procedure known as "booking." A completed pattern, partly invested with ceramic slurry, is shown in Fig. 3.

A bore extends for the length of the component, and at one end there is a hollow boss and an annular rib. For forming that portion of the pattern which incorporates the boss and rib, the mould is assembled in the following manner. The pieces *B* Fig. 2 are placed on top of the central web of the H-section body *C*, and are fastened together endwise by means of two screws.

A cavity is thus formed between a raised central portion on the body *C* and semi-circular projections on the pieces *B*, which corresponds to the annular rib. A cavity for the central boss is formed in the end of the flanged bush *D*, which is now passed upwards, through the central hole in the web of the body *C*, and located by a cross pin. Next, the member *E*, which incorporates cavities for forming part of the length of each vane, is mounted on top of the pieces *B*. These items are located by four pins which pass through bushes in the member *E*, the pieces *B*, and the body *C*. The member *E* and the pieces *B* are then secured to the body by screws, and a core plug is inserted for forming the central bore in the pattern.

On the annular rib of the casting, there are four short, small-diameter, projections, and two substantially-similar projections are also cast integral with the end face of the boss. Holes are provided in the central web of the body, into which mercury can flow to form the projections on the rib of the pattern. Pins, as indicated at *F*, are inserted in bores in the under-side of the web on the body *C*, and a eccentric hole at one end of each pin is set in line with a small-diameter hole in the web. In consequence, when the mould is filled with mercury, projections of greater length than is actually required are formed on the pattern. When the mould is being dismantled upon completion of the freezing stage, the pins *F* are turned and then removed from the body *C*. Because the holes at the ends of the pins are offset, the mercury projections are sheared off to the required length, and accurately flat end faces and sharp corners are produced.

The projections on the end face of the boss are produced in a similar manner, holes being provided at the base of the cavity in the bush *D*, into which the mercury can flow. A plunger *G*, which has a fairly large diameter bore extending for most of its length, is inserted in the bush *D*. Holes in the end face of the plunger *G* are set in line with those in the bush, by means of a stop screw and recess of the type usually provided for slip bushes for drilling jigs. When the mould has been assembled, the mercury is poured through the central bore in the plunger *G*, and enters the cavity by way of the holes for forming the projections on the end face of the boss. After the pattern has been frozen, the action of turning the plunger *G*, in order to remove it from the bush *D*, causes the projections to be sheared-off to the required length.

Next, the core plug, also the screws for securing the member *E* to the body *C* are removed, and the member *E* is withdrawn by means of an extractor shown at *H*. This extractor incorporates a disc fitted with three equally - spaced pins, which, when the mould is assembled, make contact with the

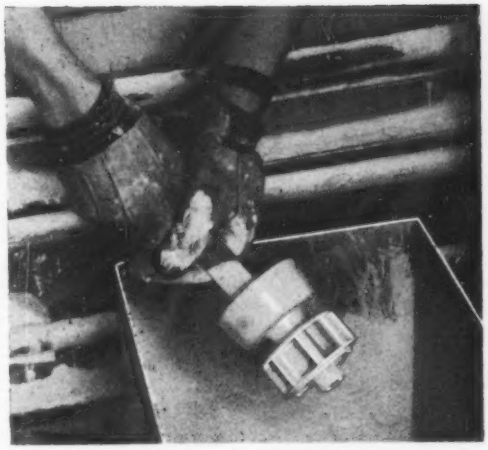


Fig. 3. The mercury pattern produced in the mould shown in Fig. 2 is here seen partly invested

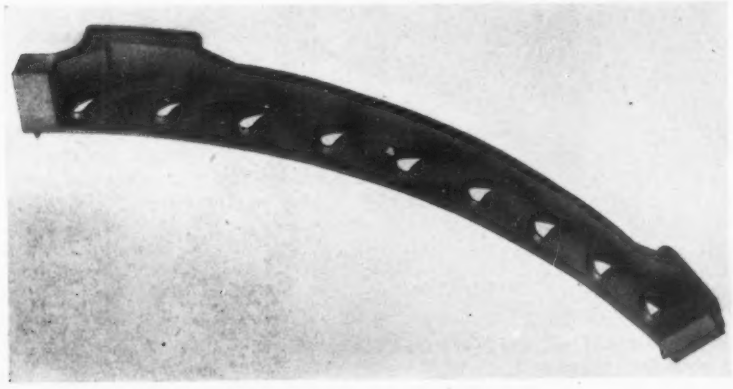


Fig. 4. This outer flange segment for holding gas turbine nozzle guide vanes is cast in Nimonic alloy

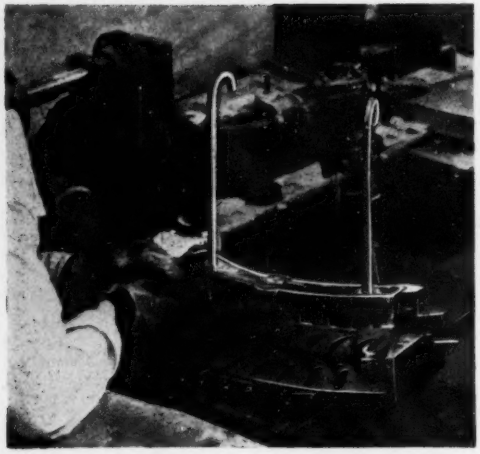


Fig. 5. The mercury pattern for the component seen in Fig. 4 is here shown just prior to removal

top faces of the pieces *B*. A central screw can be turned freely in a bore in the disc, and engages with a threaded hole in a cross bar, which passes through slots in the side pieces of the member *E*. Thus, when the screw is rotated, the extractor pins are pressed against the pieces *B*, and the member *E* is raised clear of the pattern.

The body *C*, with the half pattern and the pieces *B* in position, is suspended in the freezing tank, while the other half is being prepared. For this operation, the halves of the split mould block *J*, which incorporate cavities for producing the flange at the end of the pattern, also the pouring cup, are brought together, and then located by plungers and secured by screws. Next, the piece *K*, which has cavities for producing the vanes, is located, in contact with the lower end of the block *J*, by other plungers, and these items are fastened by screws. The core plug *L* is now passed through the bore of the piece *K*, so that its tapered end extends through a large-diameter recess in the top face of the block *J*. Finally, the core plug *L* is secured by a cross pin. Mercury is then poured into the recess in the mould block *J*.

Before freezing occurs, a piece of steel bar with a hook-shaped end is inserted in the pool of mercury in the feeder head recess, to facilitate subsequent handling of the completed pattern, as may be seen in Fig. 3. When the mould is to be dismantled after the half pattern has been frozen, removal of the piece *K* from the block *J* is carried out with the aid of the extractor *H*. For this purpose, the extractor is detached from the member *E*, and is then assembled to the piece *K*.

The block *J* is now mated with the body *C* for the purpose of bringing the joint faces of the frozen patterns into mutual contact. To ensure accurate alignment of the pattern halves during the booking operation, the plungers in the block *J* for locating the piece *K* during the pouring and freezing of the second half pattern, are passed through the bushes in the central web of the body *C* which previously received the locating pins for the member *E*. It may be mentioned here that the accuracy of alignment obtained in this way is such that no parting line is visible on the finished casting.

In Fig. 4 is shown a segment of the outer flange which holds the nozzle guide vanes at the discharge end of the combustion chambers in the Bristol Orpheus gas turbine. Weighing 1·2 lb., this component has an overall length of 14 in., and is produced by the Mercast process in a Nimonic alloy. It is noteworthy for the fact that there are considerable variations in the cross-section dimensions, which range from 2 by 0·08 in. at the central portion to $1\frac{5}{32}$ by $\frac{5}{8}$ in. at the ends.

The slots to receive the guide vanes are held to an accuracy of 0·003 in. for aerofoil shape, and to 0·01 in. for position in relation to the central slot. Other dimensions, including curvature, are held to limits of ±0·01 in. Radii at the edges are of the order of 0·005 to 0·01 in., and the surface roughness is approximately 60 micro-inches r.m.s. Machining is performed only on the ends and the thick top portion of the casting. The frozen mercury pattern and gating system are made in a single piece, without booking, and the aerofoil slots, also the raised portions round their edges, are produced by sliding core pieces on the mould. A view of the mould, with most of the core pieces removed, in readiness for withdrawing the pattern, is given in Fig. 5.

FREON SELECTIVE SOLVENT FOR CLEANING PRINTED CIRCUITS—Printed circuits, it is stated, may be safely cleaned after assembly by immersing them in a Freon solvent supplied by E. I. Du Pont de Nemours & Co., Inc., Wilmington, Delaware, U.S.A. This solvent will remove fingerprints, excess resin or soldering flux, grease, and oil, without damaging the printed circuit base or the assembled colour-coded electronic parts. Freon is a fluorinated solvent and may be used either alone, or mixed with ethyl alcohol. A suitable mixture comprises six parts of Freon and four parts of denatured anhydrous ethanol. The Freon is non-inflammable, and has the effect of raising the flash point of the alcohol.

New Production Equipment

Scrivener Duplex Face Grinder for Ball and Roller Bearing Rings

Although both sides of rings for ball and roller bearings can usually be ground simultaneously by through feeding the parts between a pair of disc-shaped abrasive wheels, this procedure has certain disadvantages when considerable amounts of metal are to be removed from large-diameter rings.

The duplex face grinder shown in Fig. 1 has recently been built by Arthur Scrivener, Ltd., 875, Tyburn Road, Birmingham 24, for handling such components. It is arranged for operation by the company's controlled-cycle system, originally developed for centreless grinders, which provides for moving the right-hand wheel-head towards the left-hand head, by cam action, as grinding proceeds. The cut is thus applied progressively to the work, and after it has been reduced to the required thickness, the movable wheel-head is caused to dwell for a variable period for sparking-out, and is then rapidly returned to the starting position. Since the cutting feed and sparking-out period are closely controlled, the work can be held to a high degree of accuracy for thickness, and wheel wear is reduced.

Referring to the diagram of the work handling equipment shown in Fig. 2, the bearing rings pass, by gravity, down an inclined chute, and the leading piece is held by a vertical stop plate and the top edge of the carrier A, which is secured to a horizontal slide. When this slide is moved to the right, at the beginning of the grinding cycle, the leading ring rolls down the cam-shaped edge of the carrier, to be located by three tungsten-carbide support pieces as indicated at *B*. The piece is then passed between the grinding wheels by continued movement of the slide. During the subsequent feed stroke and dwell period of the movable wheel-head, the slide is reciprocated, with the result that the ring is caused to rotate on the support pieces by the action of the grinding wheels. In consequence, a high degree of accuracy for parallelism of the ground surfaces is obtained on rings of 4 in. diameter and over, from which fairly large amounts of metal must usually be removed. In the diagram, the positions of the carrier at each end of the reciprocating stroke are indicated by dotted lines.

Upon completion of the sparking-out period, the

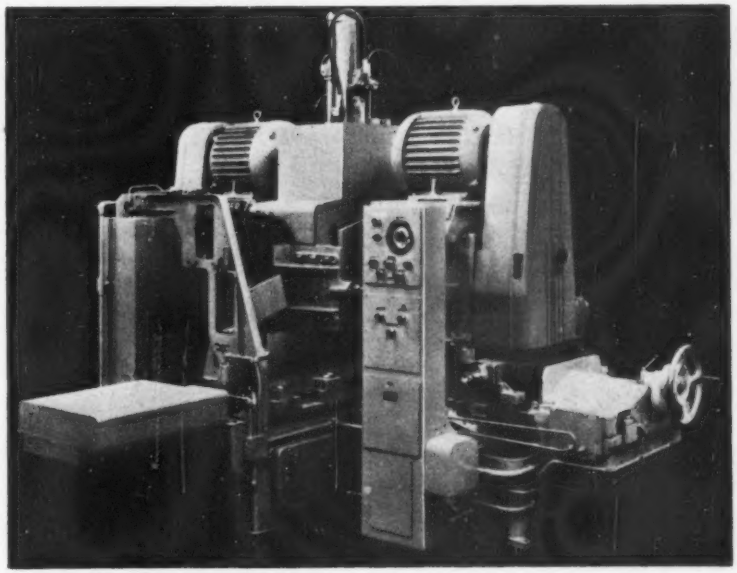


Fig. 1. Scrivener duplex face grinder, with controlled-cycle in-feed motion, for ball and roller bearing rings

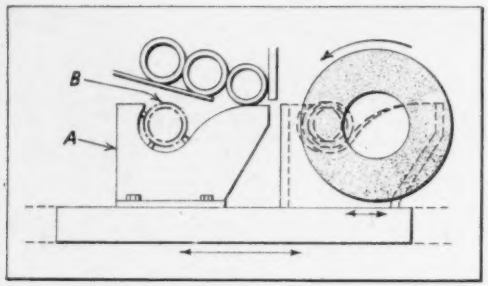


Fig. 2. Diagram showing the work handling arrangement on the Scrivener duplex face grinding machine for rings

carrier *A* is returned to the loading position and the movable wheel-head is retracted. The ground piece is then ejected from the carrier.

Both wheel-heads are carried on roller-bearing guideways, and the machine incorporates a "micro-sizer" unit, whereby the distance between the faces of the grinding wheels can be adjusted in increments from 0·0001 to 0·0005 in. by pressing a push-button. A process timer is provided for controlling the dwell period of the right-hand wheel-head. As an indication of the output capacity of the machine, it is stated that 8-in. diameter bearing rings, from which considerable quantities of stock must be removed, can be ground to close tolerances at rates up to 120 per hour.

Chambon Routing Machine

The routing machine here illustrated has been introduced by Chambon, Ltd., Riverside Works, Standish Road, London, S.W.6, for operations on flat or cylindrical parts of steel, brass, light alloy, and other metals.

Drive is taken from a motor of 0·95 b.h.p., and 2-step flat belt pulleys provide spindle speeds of 1,500 and 8,500 r.p.m. for high-speed steel and tungsten carbide cutters, respectively. A band brake, operated by a control lever through a toggle mechanism, serves to bring the spindle rapidly to rest, and at the same time a switch is tripped to isolate the driving motor. The spindle is carried in high precision ball bearings, and the driven pulley is independently mounted, to ensure that belt tension does not affect the alignment. A standard ¼-in. Crawford collet is accommodated in the the spindle nose.

Mounted on parallel rollers for easy movement, the table has a longitudinal traverse of 41 in. controlled by the handwheel at the left-hand side. Each revolution of the handwheel moves the table through a distance of 0·04 in. When flat work is to be routed it is held on a secondary table which is secured to the main table by T-bolts. Cylindrical parts, however, are held between a tailstock and an indexing head as seen in the illustration. The head is rotated, as required, through a shaft and reduction gearing, by means of the handwheel on the right, one revolution of which turns the spindle through 1 deg. Cylindrical work up to 15¾ in. diameter and 51¼ in. long can be mounted between the centres.

For height adjustment of the complete table assembly, which moves on vertical slideways, there is a crank handle at the front of the machine. A screw raises the table 0·1 in. for each revolution of the shaft. A circular scale fitted to this shaft is graduated in divisions representing 0·0004 in. of vertical movement of the table, which has a traverse of 13 in. Compressed air from the shop supply system is passed through a moisture trap to a jet, and provides for cooling the tool and removing swarf.

A motor starter unit with push-button controls is mounted on the pillar of the machine. Local lighting over the working area is provided by two lamps carried on adjustable brackets.

Chambon routing machine for cylindrical and flat parts

Heid Neomat Copying Lathe with Variable Centre Height

Newman Industries, Ltd. (Machine Tool Division), Yate, Bristol, are the sole selling agents in the United Kingdom for the type VK56 Heid Neomat straight-bed copying lathe, with variable centre height, shown in Fig. 1, which was recently demonstrated at Trafford Park, Manchester. (See MACHINERY, 93/164—16/7/58). It is believed to be the only copying centre lathe, yet built, on which the height of centres can be varied—in this particular instance from 15¾ to 22¼ in. Thus, by increasing the centre height, approximately 50 per cent greater diameter capacity is provided over the full turning length, also for surfacing.

Of 18 ft. overall length and weighing approximately 9 tons, the lathe admits 10 ft. between centres. The front bed shear, which has a V-section guideway for the saddle, is continuously flooded with oil, and is protected over the full length by telescopic stainless steel guards. A guard, extending towards the headstock, partially covers the rear saddle guideway. At all centre heights, the direction of the resultant cutting pressure is always between the bed shears.

The headstock and tailstock are mounted on inclined slides and are moved upwards and towards the rear to increase the diameter capacity. Power adjustment of the headstock centre height is provided by motor and screw, as shown in the close-up view, Fig. 2, and tailstock adjustment is made by handwheel and screw. Vernier scales are employed for re-aligning the centres, and enable an accuracy of 0·0003 to 0·0004 in. per ft. to be obtained. For greater precision, a ground test bar can be used with a dial indicator.

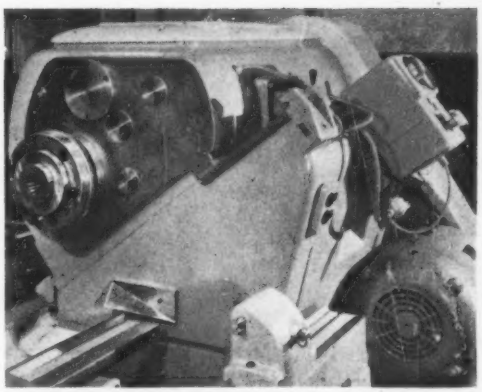


Fig. 2. Close-up rear view of headstock showing the inclined slide and vernier scale on the Heid copying lathe

Hardened and ground gears and shafts in the headstock provide a range of 21 spindle speeds, from 7·1 to 710 r.p.m. The spindle, which is bored 3·6 in. diameter, runs in two precision taper roller bearings at the front end, and is designed to take a 35½ in. diameter 4-jaw chuck. For starting, reversing, stopping and braking the spindle, Heid electro-magnetic type, multi-disc clutches, without slip rings, are employed. These clutches, which are self-compensating for wear, may be controlled from either the headstock or apron. Lubricating oil in the headstock is circulated through the cabinet leg for cooling, and a thermometer indicates the temperature. Main drive to the headstock is taken from a 25-h.p. motor, through V-belts, as seen in Fig. 2.

A totally - enclosed, quick-change, feed and screw - cutting gearbox, with no tumbler mechanism, is driven from the headstock through a telescopic shaft and spiral bevel gearing, and gives a range of 32 feeds and 64 changes of thread pitch. Sliding feeds range from 0·004 to 0·056 in. per spindle rev., and surfacing feeds from 0·002 to 0·028 in. Without the use of

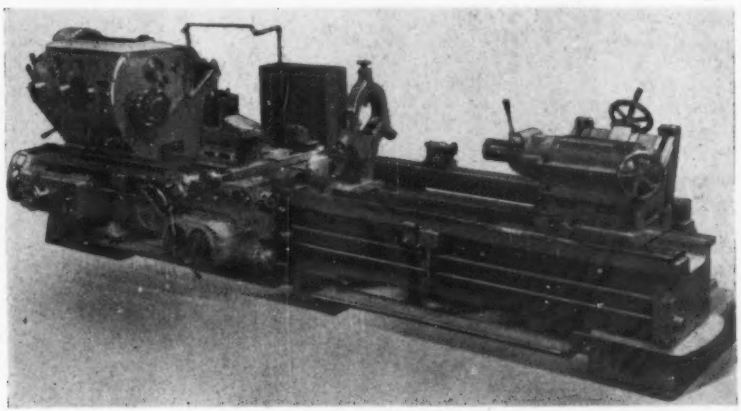


Fig. 1. Heid Neomat copying lathe with variable centre height

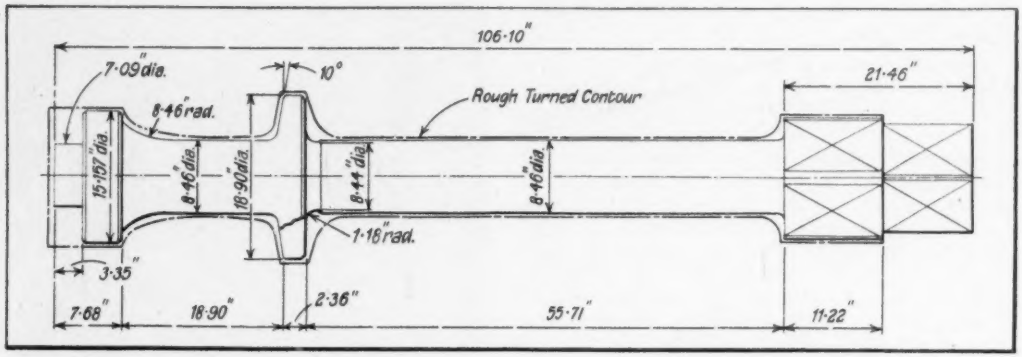


Fig. 3. Heavy diesel marine engine connecting rod which was copy-turned during a recent demonstration of the Heid lathe

change gears, Whitworth threads from 28 to ¼ t.p.i. can be cut, Metric threads from 1 to 224 mm. pitch, Module threads from ¼ to 56 and diametral pitch threads from 112 to 0·5. Rapid power traverse of the saddle is at the rate of 102 in. per min., and of the cross-slide, at 51 in. per min.

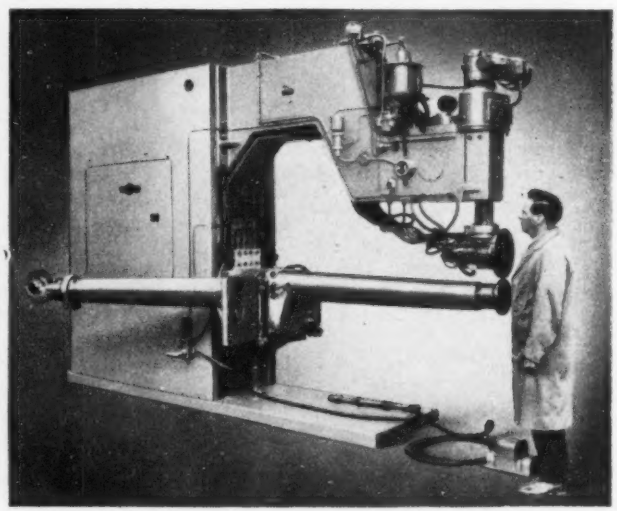
A square tool-post with accommodation for tool-holders on three sides, enables the tool position to be varied to suit the centre height. Tool-holders are clamped in position by cam action, and the tools can be ground without removing them from the holders. Oil bath lubrication is provided for the hardened and ground cross-slide screw. The apron incorporates electro-magnetic reversing clutches, which control the longitudinal and transverse feeds, and feed tripping is ensured, irrespective of the cutting load, by easily-adjustable stops of new design, in conjunction with electric precision limit switches, which open after 0·0004 in. displacement.

Copying through 180 deg. is carried out by means of the integral Heid electro-magnetic tracer control, which can be used at any centre height, and follows the contours of a master or template. The template holder accommodates four templates so that cuts can be taken successively by indexing the holder through 90 deg. Fig. 3 shows a diesel marine engine connecting rod, weighing approximately 1½ tons, which was machined with a high metal-removal rate, at the recent demonstration. This component affords an indication of the large copying capacity of the lathe and the ability to copy-turn through 180 deg.

Sciaky Type RAMUT 250-kVA Seam and Roller Spot Welder

In the figure is shown the type RAMUT, 250-kVA., seam and roller spot welder, with a throat depth of 80 in., which has recently been built by Sciaky Electric Welding Machines, Ltd., Falmouth Road, Slough, Bucks. The upper arm of this machine is specially designed for handling a particular type of component.

Roller-type lower electrodes for circumferential

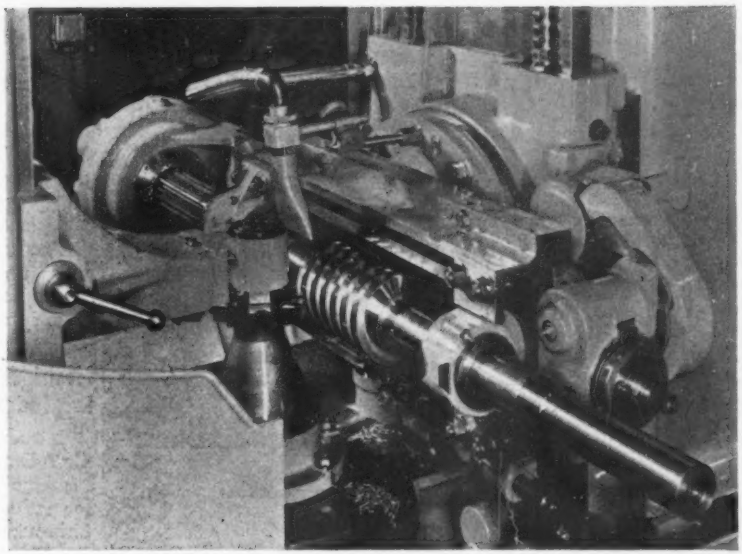


Sciaky type RAMUT, 250-kVA seam and roller spot welder

and seam welding operations are carried on separate arms which are hinged at their rear ends, and can be swung to the working position, as required, and clamped to a plate of high-conductivity copper alloy.

The upper electrode can be arranged in two positions at right angles, to suit the welding operation to be performed, and is driven by a motor through gearing and a central shaft. This motor may be run either continuously for the welding of mild steel, or intermittently for the roller spot welding of heat-resisting steels and light alloys. For intermittent operation, the motor is started and stopped by the same electronic equipment that controls the welding current. Contact pressure between the upper electrode and the work is applied by a Sciaky diaphragm-type air-operated cylinder.

The company's patent 3-phase system of welding is employed, which provides for electronic conversion of the mains frequency, compensation for induction changes, and balancing of the load on all three phases of the supply.



Close-up view of the new large-capacity tangential feed hobbing head for the Sykes type HV24 gear hobber, here shown set up for cutting a worm with a long integral shaft

Large-capacity Tangential Feed Hobbing Head for the Sykes Type HV24 Gear Hobber

W. E. Sykes, Ltd., Manor Works, Staines, Middlesex, have recently introduced a large-capacity, tangential feed, hobbing head for their type HV24 gear hobber, to permit of cutting worms with long integral shafts.

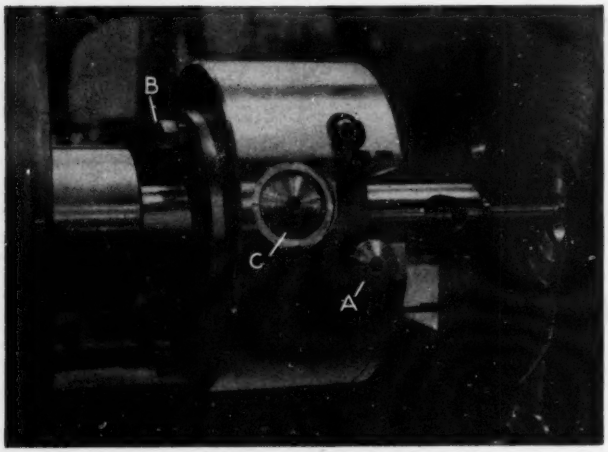
For this operation, the workpiece is mounted in the hobbing head, and the cutter is secured to the spindle which normally carries the blank when gear cutting is being performed. A close-up view of the new head set up in this way for cutting a worm is given in the illustration. The head enables worms up to 6 in. diameter by 8 in. long to be cut, and the maximum length of shaft extension at the spindle end of the worm that can be accommodated is 17 in. The corresponding length that can be handled on the standard tangential feed hobbing head which is available for the machine, is 6⅞ in.

Gears and other toothed components up to 24 in. diameter, with a face width of 15 in. and a diametral pitch of 2½, can be cut on the type HV24 hobbing machine. Climb and conventional hobbing can be employed, and the 12 hob speeds available range from 60 to 176 r.p.m.

Swintool Hydraulic Boring and Facing Head

The Swintool boring and facing head, here shown set up on a horizontal borer, has recently been introduced by Swindon Tool Co., Ltd., Trading Estate, Cheney Manor, Swindon, and is the subject of a patent application.

When a surfacing cut is being taken on the work, radial feed of the tool slide is controlled hydraulically by a valve which is adjusted by means of a knob mounted on the front end of the body. For setting the head in preparation for surfacing, and for cutting internal grooves, the feed control valve is opened, and the micrometer screw *A*, whereby the tool slide is adjusted for boring operations only, is disengaged by anti-clockwise movement of a small lever, also mounted on the front end of the body. The tool slide is then



Swintool hydraulic boring and facing head

adjusted until the tool-bit makes contact with a previously-bored hole in the work, by rotation of the shaft *B*, which extends from the front and rear of the body, and has squared portions at the ends to take a spanner.

When this has been completed, the screw stop *C* is rotated in a clockwise direction with the aid of a key, until it makes contact with a stop on the tool slide, and the reading on the micrometer dial at the outer end is noted. The screw *C* is then rotated in the opposite direction to move the stop through a distance which corresponds to the difference between the radii of the bored hole and the recess on groove to be machined. Rotation of the screw *C* through one complete revolution causes the adjustable stop to be moved for a distance of 0·1 in.

When the spindle which carries the boring head has been started, the tool slide moves radially outwards to perform the cutting operation, and is arrested at the end of the working travel by the adjustable stop. The spindle is then stopped, and the slide is returned to the central position by rotation of the shaft *B*. When a second surfacing cut is to be taken in a recess, the boring head is adjusted for depth, and release of the shaft *B* causes radial feed to be again applied to the tool slide.

In this manner, successive surfacing cuts can be readily taken on the work, and the need for disturbing the setting of the control valve and the screw *C* is avoided.

When boring operations are to be carried out, the screw *C* is turned in an anti-clockwise direction to the full extent, and, with the tool slide set in the central position, the feed control valve is closed while the screw *A* and its mating nut are brought into engagement by means of the lever on the front end of the body. The control valve is then opened, so that backlash between the adjusting screw and nut for the tool slide is eliminated hydraulically.

The head has a capacity for boring holes up to 14 in. diameter, and a larger unit is at present in course of development.

Michigan No. 999 Abrasive Finishing Machine for Hardened Gears

Introduced by the Michigan Tool Co., Detroit, Michigan, U.S.A., the machine shown in Fig. 1 provides for reducing small inaccuracies, and improving the surface finish and contact pattern on the teeth of hardened steel gears up to 12 in. diameter, with the result that the gears are quieter in operation.

Finishing is carried out by means of a "throw-away" gear-type wheel with an abrasive-impregnated plastics rim, usually of 80 grit, which is

Fig. 1. Michigan No. 999 abrasive finishing machine for hardened steel gears

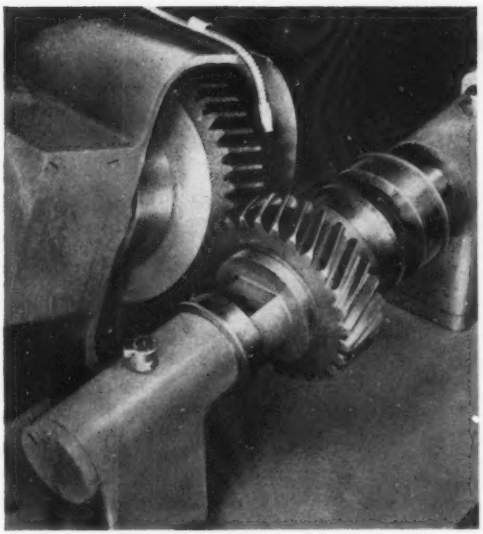


Fig. 2. Close-up view of the abrasive wheel and a workpiece on the Michigan No. 999 abrasive finishing machine for gears

run in mesh with the work as shown in Fig. 2. At the same time, the worktable is reciprocated so that the gear is traversed in contact with the abrasive wheel for its full face width. During the operating cycle, which occupies a period of slightly more than 1 min., the abrasive wheel is run in both directions, and is held in contact with the work under a constant predetermined load. Gear teeth with small amounts of crown can be handled in this manner, and an attachment is available which enables finishing operations to be performed on gears with large amounts of crown.

The 9¼-in. diameter abrasive wheels can be supplied in face widths of 1 and 1½ in. A maximum angle of 25 deg. is obtainable between the axes of the work and the wheel spindle, a scale and stops being provided to facilitate setting the swivel wheel-head. Drive from the motor to the wheelhead is transmitted by a variable-speed unit, which gives spindle speeds ranging from 52 to 283 r.p.m. Different table speeds are obtained by change gears, and the stroke is set by means of an adjustable crank.

A maximum length of 24 in. is admitted between the headstock and tailstock centres, and, if required, an air-operated tailstock can be supplied. Coolant equipment is provided, and semi- or fully-automatic work loading equipment may be fitted, to order. Designated No. 999, the machine occupies a floor space of 60 by 78 in. and weighs approximately 1 ton 15½ cwt.

Gaston E. Marbaix, Ltd., Devonshire House, Vicarage Crescent, London, S.W.11, are the selling agents in this country for the Michigan Tool Co.

Halden Uniref Combined Drafting and Reference Table

J. Halden & Co., Ltd., Rowsley Works, Reddish, near Stockport, have recently developed the Uniref combined drafting and reference table here illustrated. The drawing board is mounted on an adjustable bench stand on the top of the table, as shown, or it may be fitted to a metal pedestal which can be pushed up to the table. With either arrangement, ready access is afforded to the table from the back or sides. This table can be used in conjunction with the firm's Lancaster or Lincoln tables to provide for back reference.

The board is pivoted and may be readily locked to the bench unit. In the horizontal position, the surface is 4 in. above the table, and with the board vertical the whole of the drawing area is within easy reach. Height adjustment is unnecessary for boards below Hamburg size. Compared with conventional arrangements, when the unit is used for back or side reference, there is considerably less difference between the heights of the drawing and

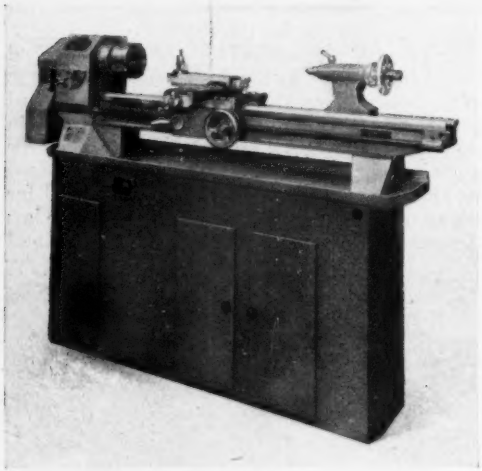
Halden Uniref combined drafting and reference table

reference areas, and the same stool can be used with comfort for both purposes.

Owing to the small floor space requirements, the unit is claimed to be particularly suitable for the small drawing office. Where the drawing board is supplied with a separate metal pedestal, complete flexibility of lay-out is possible, and the available floor space can be fully utilized. The board and bench stand can be supplied for use on a customer's existing filing cabinet or table.

Viceroy Educator 10-in. Swing Screwcutting Lathe

The accompanying illustration shows the Viceroy Educator 10-in. swing screwcutting lathe, with fabricated steel cabinet base, which has recently been introduced by Denford Small Tools (Brighouse), Ltd., Birds Royd, Brighouse, Yorks., for industrial use and apprentice-training purposes. It admits 24 in. between centres and swings work up to 5¾ in. diameter over the cross-slide. The height from the base to the spindle centre is 40 in.



Viceroy Educator 10-in. swing screwcutting lathe

Drive is taken from a ¾-h.p. push-button controlled motor, which, together with the starter, is housed in the cabinet base, through a link V-belt to the spindle, the eight speeds provided ranging from 75 to 1,300 r.p.m. The spindle, which is bored ⅛ in. diameter, runs in taper roller bearings and accommodates a No. 3 Morse taper centre. It can also be equipped wih a 3- or 4-jaw chuck, as required.

The saddle has a T-slotted upper surface, to provide for boring operations, and is guided on vee and flat ways on the cast iron bed. A compound swivel slide rest is fitted, with a transverse traverse of 6 in., and a tool rest movement of 4 in. The tool post accommodates a D.S.T. No. 0 toolholder for ¼-in. tool bits.

A lever-operated eccentric clamp secures the tailstock to the bed, and the spindle, which is of the straight-through type, is bored ⅛ in. diameter and has a traverse of 2¼ in. The electrical equipment includes a no-volt release starter with thermal overload coils for 3-phase A.C. supply, and a microisolator switch.

Douglas Wire Pak Tension Head

Avo Ltd., 92-96 Vauxhall Bridge Road, London, S.W.1, have introduced the Douglas tension-head take-off unit shown in the accompanying illustration, which enables full advantage to be taken of the latest "Pak" method of packing wire in drum containers.

The tension head is adjustably mounted on a round pillar which is readily attached to the drum container by means of two web straps. Wire from the Pak passes through a guide bush and a felt pad, on to a roller, which is braked by means of an adjustable, spring-loaded friction disc. Bearing on top of the wire as it passes over the roller is a rubberized nylon belt which can also be adjusted for tension, according to the gauge of wire which is being handled.

On leaving the tension roller, the wire passes over a grooved guide roller at the outlet side. Metal guide cones of various standard sizes are available for fitting on top of the drum containers, which are of advantage when winding is to be carried out at very high speed. The tension head will handle all gauges of wire at present supplied packed in this manner.

Douglas Wire Pak tension head

News of the Industry

Yorkshire

GREENWOOD & BATLEY, LTD., Armley Road, Leeds, are busy with home and overseas orders for cold heading machines, including high-speed types and standard machines up to ¾-in. diameter capacity. Auxiliary machinery is also in progress, including screw nickers, bolt head trimmers and thread rollers of ⅛- to ¾-in. diameter capacity. Other orders in hand cover friction screw presses up to 1,000 tons capacity and horizontal hot forging machines for bars up to 1½ in. diameter. Among special machinery on order we noted rotary-type milling machines for producing the flats on cycle axles, drilling and draw-boring machines for rifle barrels, and bench-type vertical milling machines for rifle components. The company's tool-room is fully occupied with the production of a variety of tools, jigs and gauges for specialized work.

There is a well-maintained demand for Greenbat standard and special, fixed- and elevating-platform, electric trucks, of various sizes, also for fork-lift trucks. Other activities include the production of mining locomotives, and an order was recently received from Australia for two 20-ton trolley-type, narrow-gauge locomotives, each equipped with two 150-h.p. motors.

HAYES ENGINEERS (LEEDS), LTD., Gelderd Road, Leeds, have a good order book for both standard and special versions of their Diemaster and Tracemaster precision vertical milling machines, also for the Hydrotracer hydraulic copying equipment, and for jig boring and high-speed milling attachments. Our attention was drawn to a recently-developed, heavy-duty, Tracemaster machine, which is being built in two types, one for automatic die-sinking and the other for profile milling. At a later date we hope to describe these machines more fully. The call for hydraulic copying equipment for application to customers' machine tools, and for tracer valves and hydraulic pump equipments is maintained at a good level. Orders for tracer valves and machines have recently been executed for Australia. Sub-contract work in progress includes a number of die casting machines. Among the plant installed since our last visit we noted an Orcutt gear grinding machine and a Heald internal grinding machine.

CAMPBELLS & HUNTER, LTD., Sayner Road, Leeds, report some reduction in the demand for the cutting of spur, bevel, worm and double-helical gears, and some capacity is available for spur and double-helical gears up to 8 ft. 6 in. diameter and bevel gears up to 3 ft. diameter. Gears can be cut on customers' own machined blanks, or can be supplied complete.

MIDGLEY & SUTCLIFFE, LTD., Hillidge Works, Hunslet, Leeds, are doing a good business in their standard types and sizes of plain and universal horizontal milling machines and vertical milling machines, also in standard and girder-type radial drilling machines, in sizes from 3 to 6 ft. radii.

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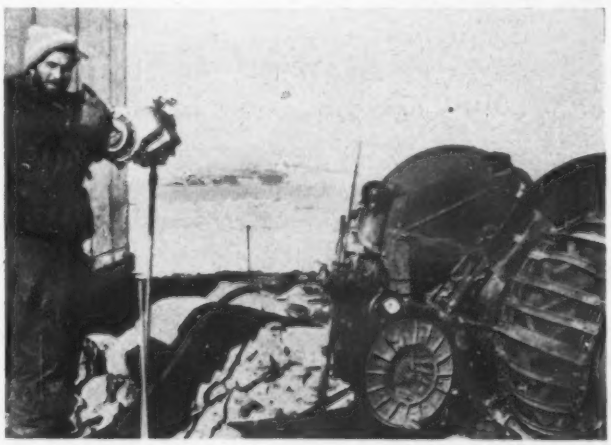
The illustration shows a Hydrovane 60 air compressor supplied by Alfred Bullows & Sons, Ltd., Long Street, Walsall, in use at Scott Base, which played an important part in the recent Trans-Antarctic expedition. This compressor was driven from the standard power take-off of a Ferguson tractor and its main function was to supply air for the removal of cuttings when boring holes with a portable diamond drill, also for conventional percussion drills and spades. It is reported that the compressor operated very satisfactorily throughout a total period of 500 hours with an average summer temperature of 15 to 20 deg. F. (T-A.E. photograph)



We may also note that orders for turret-head type milling machines are in hand. Our attention was drawn to the firm's recently-developed No. 3 vertical milling machine, which is the largest in this range. It has a 48- by 11-in. table working surface, and power feeds are provided in the longitudinal, transverse and vertical directions. Drive is taken from a 7½-h.p. motor and there are 12 spindle speeds ranging from 20 to 1,000 r.p.m., or, alternatively, from 30 to 1,400 r.p.m. Rapid power traverses are also available in all directions. A working demonstration of this machine was given recently in the showroom of Machine Tool Supplies, Ltd., 23, The Calls, Leeds.

Recent overseas destinations of the firm's products include South Africa, China, Nigeria, Belgium, Australia, Ceylon, Egypt and Turkey, and orders are at present in hand for India and Australia. The latest addition to the plant at these works is a Precimax 12- by 60-in. universal cylindrical grinding machine.

CROSTHWAITE FURNACES & SCRIVEN MACHINE TOOLS, LTD., York Street, Leeds, have a variety of work in progress, approximately 50 per cent. of which is destined for overseas. Wheel rim forming machinery for the motor car industry is particularly prominent and includes flattening rolls, circling machines, and expanding machines, together with conveyor equipment. Bar straightening rolls are on order for bright steel bar producers, and shearing and cropping machines in hand include a billet cropper for 4-in. square section steel.

H. B.

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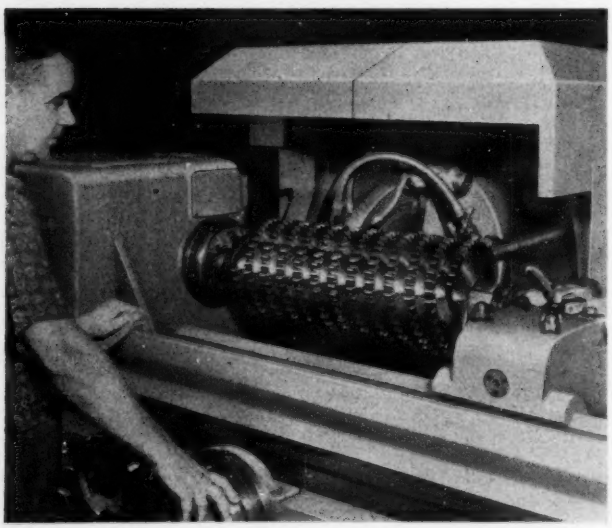
Set-up for grinding the thread form of a large worm of special type at the works of Ex-Cell-O Corporation, Detroit, Mich., U.S.A. The worm, of 10 in. outside diameter, is employed in a Johnson drive for a large machine tool table. The flanks of the worm engage a concave rack underneath the table. Drive is transmitted to the worm by a long spur gear which engages with teeth cut in the crests of the threads



London and the South

V. HUFFAM, LTD., Temple Fortune Works, Bridge Lane, N.W.11, recently installed a Sparcard machine in their servicing department for the hard-surfacing treatment of the cutting faces of milling cutters, the tips of tools, and selected areas of press tools.

The Sparcard process, which was fully described in MACHINERY, 92/687—21/3/58, provides for the transfer of material from a consumable electrode to a workpiece. If a tungsten carbide electrode is employed a wear resistant layer is deposited, and it is claimed that when such a layer is applied to high speed steel the results are extremely satisfactory.

Arrangements were recently concluded whereby this company will distribute the Larrad hydraulic adjustable vice jaw throughout the South of England. This unit, which was described in MACHINERY, 92/1357—6/6/58, enables parts of irregular shape to be gripped with uniform pressure in a vice. Small hydraulic plungers project from the surface of the attachment and conform automatically to the contours of the work.

PROTOTYPE DEVELOPMENTS, LTD., Arundel Road, Luton, Beds., who are on the A.I.D. approved list, have specialized since 1951 in the design and construction of special-purpose machines and the production of a wide range of components to close limits. Products recently introduced by this company include an automatic record player fitted with a magazine and a selector mechanism which incorporates a memory device, and a new optical projector of compact design. A satisfactory demand is being experienced for a double-jaw vice which was placed on the market five years ago. Made from high tensile iron, this vice is intended for holding short lengths of stock in hacksawing machines, and it is stated

that it enables good use to be made of off-cuts which might otherwise be scrapped. A department of the firm is engaged in the manufacture of plastics products, up to 3 oz. weight, by an injection moulding process.

CARTER SCREW & ENGINEERING CO., Datchet, Bucks, established 14 years ago, are engaged in the manufacture of dies, moulds and press tools, many examples of which have been supplied to well-known engineering establishments. Multi-stage press tools for the production of rotor and stator laminations form a high percentage of this firm's output. As a result of the company's activities in the press-tool field, the design department has recently developed a coiled-stock feeding attachment for presses. This equipment, which can be operated in conjunction with press tools running at 400 strokes per min., forms the subject of a patent, and will shortly be described in MACHINERY. The company has decided to rebuild the existing workshops, and the new premises, on completion, will extend to an area of approximately 5,000 sq. ft.

BELL PRECISION ENGINEERING CO., LTD., Victoria Works, High Street, Crawley, Sussex, have rebuilt their premises and installed additional machine tools and equipment in order to provide comprehensive facilities for the design, development and manufacture of jigs, precision fixtures, tools, moulds, gauges and special products for the aircraft industry, Government departments and firms connected with nuclear engineering projects. Four jig boring machines of Swiss manufacture are installed, as well as a range of centre lathes, milling machines, grinding machines and honing equipment. Extensive use is made of form grinding for the production of gauges for gas turbine blades, for example, the grinding wheels being shaped with the aid of a Truepath wheel-forming attachment. Three other companies associated with this firm provide additional facilities, for instance, for the production of a wide range of components on presses up to 150 tons rating.

F. W. H.

The Midlands

NICOR CO. (WILLENHALL), LTD., Park Road, Willenhall, Staffs., are well established in new premises to which they moved earlier this year. With an area of 20,000 sq. ft., the works are planned to enable special purpose machines, including transfer machines with multi-spindle tapping heads, to be constructed and tested, also to provide suitable facilities for the manufacture of master close-forging dies for gas turbine blades, the latter work being performed by specially trained tool-makers. An optical projector with a 3½-in. field and a magnification of 20× is used to check the die forms against master drawings. The works are well equipped with machine tools including two jig borers.

Checking the Concentricity of a Spindle Fitted to a Nicor Multi-spindle Tapping Head

In the accompanying illustration, a multi-spindle tapping head is seen being inspected after a running test. This head has 18 spindles for ¾-in. B.S.P. and ¼-in. B.S.F. taps, which are run at 480 r.p.m. The tapping cycle time is 20 sec.

CHARLES TAYLOR (BIRMINGHAM), LTD., Bartholomew Street, Birmingham, 5, who make a wide range of machine tools including centre and capstan lathes, spinning lathes, and power saws, for many applications, have recently opened a new showroom on their premises where facilities are provided for demonstrating machines under power. Products of this company also include a comprehensive range of chucks and other workshop equipment, and in addition to home sales, a substantial export trade is maintained.

WEBSTER & BENNETT, LTD., Foleshill, Coventry, are continuing with their expansion programme which, when completed, will provide for further substantial increases in the rate of production of vertical boring and turning mills. It may be

recalled that this company last year installed a number of machines which enabled output to be considerably expanded without the need for additional skilled labour. Since then, the machining facilities have been further improved by the provision of a David Brown No. 14 Hydrax hobbing machine and a spiral-bevel generating machine by the same makers; an Orcutt hydraulically-operated automatic gear grinder; and a Cincinnati Hydromatic milling machine. Traversing screws of several sizes are being produced on a Binns & Berry machine fitted with a Burgsmuller thread whirling head, which has enabled the output of these screws to be greatly increased.

MERCIA ENGINEERING CO., LTD., West Avenue, Wigston, Leics., report that they are still busy on sub-contract machining and assembly work, in connection with the manufacture of turbine blades and small gearboxes. The latter, it may be noted, are specially constructed for use with punched card mechanisms developed for positioning of machine tool tables. The company has facilities for the production of components to close tolerances, and a range of machine tools of modern types has been installed for this purpose.

GREY & RUSHTON (P.T.), LTD., 93 Far Gosford Street, Coventry, are engaged in the production of an extensive range of precision instruments, the majority of which are provided with vernier scales. In all, some 140 different types and sizes are available. Home sales, it is reported, are well maintained, and recent exports have included a consignment of gauges for the Middle East.

R. G. BOARDMAN (ENGINEERING), LTD., Lode Lane Industrial Estate, Solihull, Warwickshire, report that there is a good demand for their drill sleeves which are made in standard sizes with No. 1 and No. 2 Morse tapers to take straight shank drills of $\frac{1}{16}$ to $\frac{5}{16}$ in. diameter, and $\frac{11}{16}$ to $\frac{1}{2}$ in. diameter, respectively. This firm is also engaged in the production of adjustable adapters for multi-spindle drilling heads and transfer machines.

CARTER STEVENS & CO. (ENGINEERING), LTD., 188/190 Fletchamstead Highway, Coventry, an A.I.D. approved company, are actively engaged in the design and production of jigs, tools and special-purpose machines. This firm has developed and constructed a variety of equipment incorporating indexing tables for machining or assembly operations on small parts. F. W. H.

E.S.C. Steel Bar Warehouse

At the River Don Works, Sheffield, of English Steel Rolling Mills Corporation, Ltd., bar stock of round, rectangular, square, and special cross-sectional shapes, is produced at the rate of some 650 tons per week, from alloy and carbon steel billets, on a 12-in. bar, a 12-in. rod, and 8- and 10-in. capacity rolling mills.

Bars ranging from $\frac{1}{4}$ to $4\frac{3}{4}$ in. diameter, and equivalent sizes in other sections, are produced in lengths up to 30 ft. on this plant, and some materials, for instance spring steels, are despatched direct from the rolling mill shop. The remainder, which forms a considerable proportion of the quantity of bar stock produced, is stored in a central warehouse, whence it is subsequently taken, as required, for straightening, heat treatment, testing and inspection, cutting to length, bright finishing, and despatch. To provide improved facilities for the handling of bar stock, the warehouse has recently been re-organ-

A general view showing the new layout for the steel bar warehouse of English Steel Rolling Mills Corporation, Ltd.

ized, and a general view, showing the new arrangement, is given in the figure.

Bar reeling machines for straightening operations are installed at the centre of the warehouse, and at the sides and one end there are racks of tubular steel construction for the storage of bars. The heat treatment shop is located in an adjacent bay at the right-hand side of the warehouse, as viewed in the illustration, and in a third bay, also at the right, there are tables and additional racks where finished bars are inspected and stored in readiness for despatch. Centreless grinders for the bright finishing of bar stock are installed in a fourth bay, at the left-hand side of the warehouse.

Built by Tubewrights, Ltd., each storage rack will take loads weighing up to 15 tons, and has six pairs of horizontal arms for supporting bar stock. Stacking, at heights up to 10 ft., and transport of bars from the storage racks to the reeling machines, and between the different shops, is carried out with two Irion (see MACHINERY, 88/720—11/5/56) and one British-built Kestrel side-operating fork lift carriers, each of 3 tons capacity, which were supplied by Materials Handling Equipment (Great Britain), Ltd.

Before the re-organization was undertaken, rolled steel bars, in bundles, were stacked on top of each other in the warehouse, and for subsequent handling, four overhead electric cranes, and transfer bogies and lorries, were employed. A particular disadvantage of this arrangement was that considerable handling of bars was required in order to remove a bundle from near the bottom of a stack. Moreover, a driver and two slingers were required for working each crane, whereas each fork lift carrier now employed is operated by one man.

Personal

MR. JAMES ROYCE has been appointed a director of Hedin, Ltd., South Woodford, London, E.18.

MR. G. H. THACKRAH has been appointed sales manager of Markland Scowcroft, Ltd., Bromley Cross, near Bolton.

MR. R. F. GARDNER, works manager, of Talbot-Ponsonby & Co., Ltd., Langrish House, Petersfield, Hants., has been appointed to the board as works director.

MR. J. HIGGINBOTHAM has been appointed deputy general manager of Edgar Allen & Co., Ltd., Imperial Steel Works, Sheffield, 9, and MR. J. D. STUDHOLME, assistant general manager.

MR. R. F. HATTO, sales director of Wolf Electric Tools, Ltd., Pioneer Works, Hanger Lane, London, W.5, has retired after 45 years' service. He joined the company in 1913 and soon became associated with the sales side. After the first world war he was appointed sales manager of the Electric Tool Division. In recognition of the success of the sales policies which he introduced, Mr. Hatto was made sales director in 1939. During the second world war he was concerned with production management, and subsequently resumed responsibility for sales.

CAPTAIN R. L. JORDAN, who was recently appointed a director of Fawcett Preston & Co., Ltd., has also been elected to the boards of Brookhirst Switchgear, Ltd., Chester, and Farmer Bros. (Shifnal), Ltd., Shifnal, Salop. All three companies are members of the Metal Industries Group.

MR. WILLIAM H. MCFADZEAN has been appointed deputy president of the Federation of British Industries, 21 Tothill Street, London, S.W.1. He is chairman and managing director of British Insulated Callender's Cables, Ltd., and is on the board of other companies in the B.I.C.C. group. He is also vice-chairman and industrial leader of the Advisory Council on Middle East Trade.

Induction Hardening In lation

IN MACHINERY, 93/640—17/9/58, in an article describing operations on main-shafts for the Borg-Warner automatic transmission, it was stated, in connection with the high-frequency induction-hardening operations, that a special Ther-Monic unit was employed. We are informed by Wild-Barfield Electric Furnaces, Ltd., Watford, that they modified this installation by providing a remotely-controlled, solenoid-operated, 2-station system, and supplied a Wild-Barfield-A.H.F., 40-kW., induction-heating generator, which was substituted for the original 50-kW. unit. With this arrangement, the generator control panel is conveniently mounted above the handling fixture and a power control is fitted at each station. Provision is thus made for automatic selection when the individual station cycles are initiated, so that they can be operated independently.

Metal Industries Acquire Towler Bros.

It is announced by Sir Charles Westlake, the chairman of Metal Industries, Ltd., that the Group has recently acquired the whole of the share capital of the previously privately-owned firm of Towler Brothers (Patents), Ltd., Rodley, Nr. Leeds, and of the subsidiary, Electraulic Presses, Ltd. No substantial alterations to the operations of the company are envisaged, and the existing board of directors, including the present managing director, Mr. F. H. Towler, will continue to be responsible for its activities.

Standard for Gear Hobbing Machines

British Standard 3013 : 1958 (gear hobbing machines for small precision gears), is concerned with gear hobbing machines having a worm-driven table or chuck for producing precision gears up to 3 ft. diameter. Machines in which the table is driven by means other than a worm, or in which the hob saddle is driven by means other than a screw, should comply with this standard in so far as it is applicable.

The standard is divided into sections devoted to materials,

design, and general construction; inspection and testing; accuracy of the hob saddle motion, hob spindle, and arbor; the main indexing worm, and the accuracy of the worm assembly; master wheels; table motion; and the accuracy of test gears. There are two appendixes, concerned with the stress-relief annealing of iron castings and the heat-treatment of lead screws. Curves are included for the permissible transverse pitch errors for master wheels and test gears.

Copies of this standard can be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1. (price 6s. net).

Landis Lund, Ltd.

The Landis Tool Co., Waynesboro, Pennsylvania, U.S.A., have acquired all the issued share capital of John Lund, Ltd., Cross Hills, Nr. Keighley, and the name is being changed to Landis Lund, Ltd. Mr. John E. Hill will continue as managing director, and Mr. J. H. Smith as director and secretary. Mr. M. A. Hollengreen, president of the Landis Company, and of the United States subsidiary Gardner Machine Co., Beloit, Wisconsin, will be chairman of Landis Lund, Ltd., and Mr. R. F. Ingram and Mr. C. L. Whitaker will also be directors.

With the addition of the well-known Landis automatic cam, crank, and multi-wheel grinders, and Gardner double-disc precision grinders, the new company, it is believed, will produce one of the most complete ranges of external cylindrical and disc grinding machines in Europe.

Coming Events

INCORPORATED PLANT ENGINEERS. *London Branch.* October 7, at 7 p.m., at the Royal Society of Arts, John Adam Street, Adelphi, Strand, W.C.2; paper on "The Free Piston Engine and Its Application," by R. W. S. Mitchell, B.Sc.

INSTITUTION OF PRODUCTION ENGINEERS. *Leicester Section.* October 9, at 7.15 p.m., at Wadkin, Ltd., Green Lane Works, Leicester; paper on "Development of High Speed Machining Techniques for Non-ferrous Materials," by S. Radcliffe, B.Sc.(Tech.).

Books Received

TORSION BARS. English Steel Corporation, Ltd., River Don Works, Sheffield, 9. 23 pp.

This interesting book offers technical information regarding the design, application, and manufacture of torsion bars. Formulae are given for use when designing such bars, and a description is included of the process of presetting uni-directional bars whereby a preliminary twist is applied and the bar is strained beyond the elastic limit to counteract the stresses imposed in service. The advantages obtainable from a shot-peening process are discussed, and the final section of the book is devoted to useful conversation tables, and to the British and German specifications for serrated holes and shafts. Potential users can obtain copies of this book, free of charge, on application to the publications editor at the above address.

WIGGIN NICKEL ALLOYS *versus* CAUSTIC ALKALIES.—Henry Wiggin & Co., Ltd., Thames House, Millbank, London, S.W.1. 51 pp.

In this book, a description is given of the properties of the high-nickel alloys which are employed in the construction of plant for handling caustic soda. To assist in the selection of the best grade of material for a specific application, a guide is presented in the form of extensive data on comparative corrosion rates, which were obtained from a large number of tests conducted both in the laboratory and in actual chemical installations. Copies of this book are available for chemical engineers and designers, free of charge, on application to the company at the above address.

STEEL, KEY TO BRITAIN'S FUTURE. *News Chronicle* Book Department, 12/22 Bouverie Street, London, E.C.4. (32 pp., 1s. 6d.).

This booklet is No. 14 in the series Background to the News and deals with the position of the steel industry in relation to the country's economy, and its importance with regard to the future and to improvement of the standard of living. Comparisons are drawn between the prices of various types of steel products made by the United Kingdom, the U.S.A., Germany, France, and Belgium, and a table is given of the estimated increase in steel consumption by various industries during the next four years. Other sections discuss the latest developments in steel producing processes and labour relations within the industry.

Obituary

MR. E. G. PICKERING, a joint managing director of Johnson, Matthey & Co., Ltd., 73-83 Hatton Garden London, E.C.1, died on September 16, after a long illness.

MR. F. O. HICKLING of Ransome & Marles Bearing Co., Ltd., Newark-on-Trent, died recently. He had held the position of technical manager to that company for the past thirty years, and was well known as an authority on ball and roller bearings and their application.

MR. W. K. NORTH died recently in the Milford Memorial Hospital, at the age of 55. He had been in ill health for the past two years. Before the second world war, Mr. North was with Soag Machine Tools, Ltd., and after the war he held positions with E. H. Jones (Machine Tools), Ltd., and Stuart Davis, Ltd. More recently he was Southern Area representative for Veasey & Sharples, Ltd., Broad Lane, Coventry.

MR. NEIL HEYWOOD, managing director of Talbot Ponsonby & Co., Ltd., Langrish House, Petersfield, Hants., was killed recently, in a motor car accident, while on holiday in Spain. Born in South Africa, Mr. Heywood was educated at Harrow and Oxford, and served an apprenticeship with Metropolitan-Vickers Electrical Co., Ltd., Manchester.

He held posts with the de Havilland Aircraft Co., Ltd., and Standard Motor Co., Ltd., during the war and joined Talbot-Ponsonby Co., Ltd., in 1945.

Trade Publications

BRITISH RESIN PRODUCTS, LTD., Devonshire House, Piccadilly, London, W.1. Technical information sheet No. 8 dealing with the effects of various processing techniques on the density of parts produced from Rigidex high-density polyethylene.

THE NEW CONVEYOR CO., LTD., Brook Street, Smethwick, Birmingham, 40. Catalogue giving examples of a number of installations of Newcon swarf and scrap plants. A schematic diagram is included of the complete layout for an oil reclamation system, and diagrammatic drawings are presented of three Newcon swarf plants now in use on the Continent.

J. E. BATY & CO., LTD., Burgess Hill, Sussex. Ninth edition of the company's dial gauge catalogue, which includes the latest types of dial indicators, projectors, and measuring instruments. Extending to 49 pages, this catalogue is fully illustrated and indexed, and includes full-scale line drawings of the various types of dial faces and graduations which are available.

KEITH BLACKMAN, LTD., Mill Mead Road, Tottenham, London, N.17. Publication No. 41 is devoted to the Tornado range of small fans and blowers for ventilating and cooling duties in connection with industrial equipment. These units are of the axial, centrifugal, and propeller types, and are available in a range of sizes and different mountings.

VICTOR PRODUCTS (WALLSEND), LTD., G.P.O. Box No. 10, Wallsend-on-Tyne. Technical bulletin No. 34 giving definitions of, and formulae associated with, various photometric terms, including luminous intensity and light flux; polar diagrams; illumination; and brightness or luminance. The polar diagrams for a number of typical fittings from the company's range are also given.

R. H. COLE (OVERSEAS), LTD., 2 Caxton Street, Westminster, London, S.W.1. Two catalogues describe the range of coil winding machines made by Willy Aumann, KG, Loehne, Germany, for whom the company are the sole distributors in the United Kingdom. There is a wide range of these machines for a large number of different applications, and take-off stands and drums for fine-, medium-, and heavy-gauge wires are also available.

BRISTOL TOOL & GAUGE CO., LTD., Church Road, Kingswood, Bristol. Brochure describing the facilities offered by the company for the design and manufacture of all types of precision tooling equipment, including jigs, fixtures, gauges, die casting dies, press tools, also moulds for compression, transfer, and injection moulding of plastics. The company also undertakes the design of special-purpose machines, and can handle contract jig boring, profile grinding, and heat-treatment.

BRITISH MONORAIL, LTD., Wakefield Road, Brighouse, Yorks. Comprehensive and fully-illustrated loose-leaf catalogue of the company's overhead handling equipment. There are three main sections, devoted to the various sizes and types of the basic MonoRail equipment and the associated runners and trolleys; manually- and electrically-operated MonoRail mounted cranes; and photographs and descriptions of a large number of installations in which MonoRail equipment has been used. Dimensional details are included for all the equipment, where relevant, also particulars of the Kant-Shock safety-type shielded bus-bar for use with MonoRail track and crane systems.

BARLOW-WHITNEY, LTD., 2 Dorset Square, London, N.W.1. Data sheet No. ZMP-558 is concerned with the recently-introduced ZMP series of portable metal melting pots. Designed to operate at temperatures up to 600 deg. C., these pots can be used for a variety of applications, such as dip galvanizing and tinning, and are provided with thick-walled crucibles.

Scrap Metals

†LONDON.—‡Prices per ton for non-ferrous scrap metals free from iron are as follows:—clean copper wire, untinned and free from lead and solder, £170; clean heavy copper, untinned and free from lead and solder, £160; copper, wire, No. 2, £154; clean light copper, £149; braziery copper, £133; gunmetal, £136; brass, mixed, £95; lead, net, £56; zinc, £30; cast aluminium, £92; old rolled aluminium, £111; battery lead, £29; unsweated brass radiators, £85; hollow pewter, £498; black pewter, £368.

MIDLANDS.—It is still difficult for merchants in the Midlands to dispose of the daily output of scrap from local factories, and yard stocks have shown little signs of reduction in spite of the fact that limited tonnages are being loaded for export.

Heavy steel to No. 2 specification is not wanted in the Black Country and merchants can only load odd wagons for markets in other areas. The output of chipped steel turnings is still fairly high and consumers' allocations are filled without difficulty. Large tonnages of chipped turnings are being held in stock by merchants until the situation improves. Cast iron borings are moving more freely and there has been an improvement in the demand for cast iron. Limited tonnages of light steel and compressed destructor scrap are being moved but demand is insufficient to account for day-to-day production.

Markets for short heavy steel scrap are very limited and yard stocks are still increasing. Light scrap of all grades is difficult to clear and light iron and bushy turnings are still being " tipped " in the Midlands.

It is now possible to hope that the general trading position will slowly improve as scrap exports continue and home demand increases.

Current maximum control prices, delivered consumers' works, are now: *Heavy steel No. 1, 217s. 6d.; *heavy steel No. 2, 196s.; *heavy steel No. 4, 207s. 6d.; *heavy steel No. 5, 195s. 6d.; light iron No. 8, 149s.; short turnings No. 9 (free from alloy), 167s. 3d.; light steel No. 11, 164s. 3d.; bushy turnings, 117s.; short alloy turnings, 160s. 9d.; short steel No. 2, 233s. 3d.; machinery cast, 233s.

Prices may be increased up to 2s. 6d. per ton according to quantities tendered over a given period.

* For use by Round Oak Steelworks, Brierley Hill, increase by 1s. 6d. per ton.

† George Cohen, Sons & Co., Ltd., 600 Commercial Road, E.14.

‡ Subject to market fluctuations.

Industrial Notes

A SPARK EROSION MACHINING SERVICE is now included among the tooling facilities offered by Lennie & Thorn, Ltd., Western Road, Bracknell, Berks.

THE 1958 CYCLE AND MOTOR CYCLE SHOW, which is to be held at Earls Court, London, from November 15 to 22, will be opened by the Rt. Hon. Harold Watkinson, M.P., Minister of Transport and Civil Aviation.

THE HOFFMANN MANUFACTURING CO., LTD., Chelmsford, Essex, have taken possession of larger premises for offices and stockrooms in Glasgow, and the new address is 75 Robertson Street, Glasgow, C.2 (telephone number, Central 0468).

MACHINE TOOL ORDERS booked in June were valued at £5,342,000, including £1,220,000 for export. Deliveries during the month totalled £6,955,000, including £1,682,000 for export. Orders in hand at the end of June amounted to £65,493,000, of which £16,399,000 was for export.

THE NORTH LONDON GROUP OF THE ENGINEERING INDUSTRIES ASSOCIATION recently held a luncheon meeting for representatives of member firms, which was followed by a film entitled "Fire Control in Industry," made recently by Colt Ventilation, Ltd., Surbiton, Surrey.

"MORE FOR YOUR MONEY" is the title of a new 15-min. colour film recently released by Brook Motors, Ltd., Empress Works, Huddersfield. It is concerned with the firm's new C type motor to B.S.S. 2960-1958 a description of which was published in MACHINERY 93/736–24/9/58.

DAVID MOSELEY & SONS, LTD., Ardwick, Manchester, have introduced a new type of oil-resistant conveyor belting suitable for carrying oil-covered machined parts, for example. The belting is of laminated construction, and incorporates a synthetic rubber facing supplied by British Geon, Ltd.

K.D.G. INSTRUMENTS, LTD. (in association with Stow Partners, Ltd.), Manor Royal, Crawley, Sussex, have opened a London sales and service office, also a showroom, at 100 Fleet Street, E.C.4 (telephone number, Fleet Street 5354). Technical sales staff are in attendance, also service engineers for the London area.

INTERNATIONAL PLASTICS TRADE FAIR will be held at Dusseldorf, Western Germany, from October 17 to 25, 1959, and there will be some 540 exhibitors including 14 British and four American firms. Full details may be obtained from John E. Buck & Co., Ltd., 47 Brewer Street, Piccadilly, London, W.1.

ANGLO/DUTCH TRADE COUNCIL.—The Federation of British Industries and the Association of British Chambers of Commerce were jointly responsible for the recent formation of the Anglo/Dutch Trade Council, which was officially inaugurated on September 18. With headquarters at 99 Jan Van Nassaustraat, The Hague, Holland, the Council has been formed to promote trade between the United Kingdom and the Netherlands; to assist United Kingdom exporters with advice in obtaining agents and market information, and arranging for special trade promotion schemes and exhibitions; also, to make representations on trade matters to the Netherlands government and other authorities.

COVENTRY CLIMAX ENGINES, LTD., are forming a new company to promote export sales of their products and those of the associated firms. This new company will operate from the Coventry Climax London offices at 163 Piccadilly, W.1. The chairman will be Mr. Leonard P. Lee, and Mr. J. Peter Ford, who has resigned from his position as group sales director of Associated British Engineering, Ltd., is to be appointed managing director.

IMPERIAL CHEMICAL INDUSTRIES, LTD., Millbank, London, S.W.1, announce that they are to undertake the erection of the first plant in Europe for the production of wrought beryllium. The plant will produce this metal in the form of rod, tube, and plate, also finish machined parts, and its primary purpose will be to supply beryllium fuel cans to the United Kingdom Atomic Energy Authority for use in nuclear reactors.

WILD-BARFIELD ELECTRIC FURNACES, LTD., Elecfurn Works, Otterspool Way, Watford By-Pass, Watford, Herts., inform us that the NRC type 912 vacuum fusion gas analyzer, for the determination of the oxygen, hydrogen, and nitrogen contents of metals, is now available as a British-built unit. One of these units has been installed at the above address, and demonstrations can be arranged by appointment.

COMMUNICATION SYSTEMS, LTD., Norfolk House, Norfolk Street, London, W.C.2, have developed a special amplified speech system for use in test bays for jet engines, for example, where the noise level prohibits normal methods of communication. The personal equipment consists of padded earphones and a larynx microphone, and three of these systems have recently been installed at the altitude test plant of Rolls-Royce, Ltd., Derby.

THE BRITISH INSTITUTE OF MANAGEMENT, Management House, 80 Fetter Lane, London, E.C.4, are to hold a one-day conference, on October 21, with the theme "Computers—Top Management Appraisal." The conference, at which Mr. John Diebold, director of Urwick Diebold, Ltd., and president of John Diebold and Associates Inc., New York, U.S.A., will be the leading speaker, will be held at the Connaught Rooms, Holborn, London.

INSTITUTION OF PRODUCTION ENGINEERS AWARDS FOR 1956/57.—The winner of the Silver Medal for the best paper presented by a member of the Institution during 1956/57 was Mr. J. A. Grainger, A.M.I.Mech.E., M.I.Prod.E., A.M.I.I.A. His paper, which was entitled "New Techniques in Sheet Metal Forming," was published in the September issue of the Institution's journal. The non-member's Silver Medal was awarded to Mr. A. J. Thompson, B.Sc., A.M.I.C.E., for his paper "Measuring and Forecasting Cost Data in Highly-variable Production," which appeared in the December issue of the journal. Both prize-winners will receive their awards at the annual

dinner of the Institution, to be held at the Dorchester Hotel, London, on October 29.

A 3-DAY COURSE ON INDUSTRIAL AND FACTORY LAW has been organized by the Industrial Welfare Society, Robert Hyde House, 48 Bryanston Square, London, W.1, and will be held at the above address on October 21 to 23. The course will cover those aspects of the subjects which concern industrial managers and executives, and the lecturer will be Mr. Harry Samuels, O.B.E., M.A., barrister-at-law.

THE STANDARD MOTOR CO., LTD., Canley, Coventry, announce that they are extending their activities into the industrial field by the introduction of a range of engines suitable for providing motive power for a wide variety of equipment, including fork lift trucks, generating, welding, and pumping sets, compressors, and mobile and static cranes, for example. The engines are of the petrol, vaporizing oil, and diesel types, and range from 18 to 85 b.h.p.

SUGGESTION SCHEME POSTERS.—The Industrial Welfare Society, Robert Hyde House, 48 Bryanston Square, London, W.1, are publishing a series of coloured posters to be used in conjunction with the employees' suggestion schemes which are operated by many firms in this country. These posters, of which six different designs are at present available, can be obtained from the Society at the above address, price 2s. 6d. each. New designs will be issued each quarter, in groups of three, starting in January, 1959.

BIRLEC-EFCO (MELTING), LTD., is the title of a new company which has been formed jointly by Birlec, Ltd., and Efco, Ltd., to design and supply all types of electric melting furnaces for the ferrous and non-ferrous metals industries, together with smelting furnaces and induction heating equipment. It should be noted that the founder companies will continue to manufacture, independently, their own ranges of heat-treatment and other plant. The offices of the new company will be at Aldridge, Staffs.

AUCTION SALES OF MACHINE TOOLS and miscellaneous stores from the Command Ordnance Depot, Coypool, Marsh Mills, Plymouth, and from the M.O.S. Storage Depot, Byley, Middlewich, Cheshire, will be held at Kinterbury House, St. Andrews Cross, Plymouth, and at the New Islington Public Hall, Ancoats, Manchester, on October 3 and 7, respectively. The auctioneers will be Wooland, Son & Manico (Dept. N.), Kinterbury House, St. Andrews Cross, Plymouth, and J. H. Norris & Son (Dept. N.), 9 Albert Square, Manchester, 2.

PROCESS HEATING FOR INDUSTRY is the theme of an exhibition which is at present being held at the Merseyside and North Wales Electricity Board Development Centre, Paradise Street, Liverpool, and will continue until October 10 (excluding October 4). Organized jointly by the Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, and M.A.N.W.E.B., the exhibition includes a complete paint stoving plant which demonstrates the high production rates obtainable for this type of work by the use of Metro-Vick infra-red projection equipment. Other exhibits include tyre driers, immersion heaters, and workshop process heaters, also a Birlec heat-treatment furnace and numerous items from the range of workshop heating appliances made by Barlow Whitney, Ltd.

RHODES, BRYDON & YOUATT, LTD., Gorsey Mount Street, Stockport, have recently opened offices at Griffin House, Ludgate Hill, Birmingham, 3 (telephone No. Central 8911-2), and at 60 Highbury, Jesmond, Newcastle-upon-Tyne, 2 (telephone No. 81-4722), to provide improved sales and service facilities in the Midlands and Northern Counties. The Midlands area manager, Mr. C. M. Saunders, is in charge of the Birmingham office, and the Newcastle premises are under the supervision of the Northern Counties manager, Mr. M. J. B. Hodgson, B.Sc.

THE ROYAL NATIONAL INSTITUTE FOR THE BLIND, 224 Great Portland Street, London, W.1, has recently published a report on its activities for the year ending March, 1958. In a foreword, the chairman of the Institute's Executive Council, Mr. Godfrey Robinson, C.B.E., points out that the aim of the Institute has always been to assist the blind in achieving maximum independence, and states that 365 blind men and women were placed in competitive employment during the past year. The report is fully illustrated, and describes the various facilities and training schemes provided by the Institute.

AMOS OF EXETER, LTD., 79-80 Cowick Street, Exeter, Devon, inform us that, as from August 1 last, all sales of their products are being handled direct. Mr. Donald H. Hartley, 29 Dacres Road, S.E.23, has been appointed sales representative for the Greater London area, and Mr. T. McNaughton, 42 Rosslyn Avenue, East Kilbride, Glasgow, for Scotland. Both these representatives hold sample ranges of the company's instruments. Test equipment made by the Instrument Division includes the type 140 transistorized D.C. voltmeter, the type 156AF output meter, the type 163 valve voltmeter, and the type 138 miniaturized visual-aural signal tracer.

BRITISH MACHINE TOOL

Exports of New Machine Tools

Countries	Vertical Boring Machines		Other Boring Machines		Drilling Machines		Grinding, Lapping and Honing Machines		Automatic Lathes		Capstan and Turret Lathes		Other Lathes		Screwing Machines	
	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value. £	Quantity. Cwt. and No.	Value. £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £
Commonwealth																
South Africa	170 (1)	3,806	—	—	264 (32)	3,160	399 (23)	10,218	34 (1)	2,308	552 (8)	23,379	202 (14)	4,851	—	—
India	3 (3)	194	280 (2)	12,512	1,600 (102)	52,828	363 (15)	17,157	59 (1)	2,320	1,426 (28)	50,280	36 (3)	1,465	78 (3)	5,088
Pakistan	37 (1)	2,292	14 (3)	899	122 (6)	2,682	25 (5)	575	—	—	—	—	—	—	—	—
Australia	4,621 (3)	89,119	422 (1)	10,995	537 (13)	11,342	773 (11)	22,442	170 (2)	8,840	287 (12)	11,172	414 (19)	12,184	36 (2)	3,396
New Zealand	180 (1)	4,100	17 (6)	422	—	—	37 (14)	992	30 (1)	2,541	157 (2)	5,622	176 (31)	5,902	—	—
Canada	—	—	—	—	342 (12)	7,318	250 (12)	9,000	—	—	—	—	650 (24)	19,497	—	—
Miscellaneous	—	—	113 (4)	6,974	946 (77)	20,663	260 (39)	7,542	35 (1)	1,549	178 (2)	7,675	640 (28)	23,717	85 (2)	3,545
Foreign																
Soviet Union	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sweden	—	—	36 (1)	2,711	30 (2)	992	8 (4)	641	112 (1)	6,574	398 (7)	17,257	—	—	—	—
Norway	—	—	206 (1)	6,873	—	—	25 (1)	972	—	—	—	—	27 (3)	973	—	—
Denmark	—	—	—	—	1 (1)	94	2 (2)	182	—	—	21 (1)	1,800	26 (1)	605	—	—
Western Germany	—	—	—	—	6 (1)	179	15 (1)	1,780	—	—	—	—	22 (3)	881	—	—
Netherlands	—	—	—	—	62 (7)	2,907	9 (5)	207	20 (1)	820	281 (6)	9,685	55 (1)	1,470	5 (1)	135
Belgium	—	—	—	—	2 (1)	58	1 (1)	28	—	—	—	—	29 (6)	1,078	—	—
France	—	—	1 (1)	288	—	—	—	—	201 (2)	12,213	—	—	38 (17)	1,349	—	—
Switzerland	—	—	—	—	20 (2)	694	47 (3)	2,341	—	—	—	—	12 (3)	374	1 (1)	97
Spain	—	—	—	—	219 (5)	10,740	142 (2)	7,837	143 (2)	7,664	146 (5)	7,547	—	—	—	—
Italy	—	—	—	—	25 (1)	1,414	33 (2)	1,891	—	—	—	—	35 (2)	2,366	—	—
U.S. America	177 (1)	3,939	145 (1)	12,100	120 (3)	2,920	35 (4)	2,766	290 (2)	12,139	57 (2)	4,261	480 (17)	13,994	—	—
Miscellaneous	1 (1)	215	6 (4)	615	381 (37)	8,506	724 (100)	23,825	—	—	137 (6)	9,636	1,885 (50)	61,909	5 (1)	382
Total	5,189 (11)	103,665	1,240 (24)	54,389	4,677 (302)	126,497	3,148 (244)	110,396	1,094 (14)	56,968	3,640 (79)	148,314	4,727 (222)	152,625	210 (10)	12,643
Amendments to previous accounts																
Commonwealth	+152 (+2)	+3,000	−152 (−2)	−3,000	−88 (−1)	−1,753	—	—	−22 (—)	+2,507	—	—	+22 (+8)	−2,507	—	—
Foreign	—	—	—	—	+18 (+1)	+534	+63 (+3)	+8,400	—	—	—	— 534	−117 (−6)	−3,771	—	—

Total exports of reconditioned machine tools:—Quantity: No., 45; weight, 3,448 cwt.; value, £52,219.
Total exports of imported machine tools:—Quantity: No. 20; weight, 364 cwt.; value, £20,828.

Imports of New Machine Tools

Country of Origin	Boring Machines		Drilling Machines		Gear-cutting Machines		Grinding, Lapping and Honing Machines		Automatic Lathes	
	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £
Western Germany	275 (3)	13,995	23 (18)	3,359	440 (6)	32,279	928 (33)	49,715	315 (12)	13,614
Belgium	159 (1)	5,855	—	—	—	—	—	—	—	—
France	336 (1)	10,637	55 (4)	1,323	—	—	19 (2)	875	587 (8)	33,698
Switzerland	236 (6)	21,415	7 (3)	716	47 (5)	5,538	110 (13)	11,573	507 (21)	33,902
U.S. America	—	—	—	—	107 (2)	10,611	516 (11)	70,698	211 (5)	19,526
Miscellaneous	207 (2)	5,174	39 (3)	1,217	86 (1)	3,512	266 (17)	13,653	5 (1)	1,962
Total	1,213 (13)	57,076	124 (28)	6,615	680 (14)	51,940	1,839 (76)	146,514	1,625 (47)	102,702
Amendments to previous accounts										
Western Germany	—	+79	—	—	—	−16	—	—	—	—
Belgium	—	—	—	—	—	—	—	—	—	—
Switzerland	—	—	—	—	—	—	—	—	—	+40
U.S. America	—	—	—	—	+59 (—)	—	—	—	—	—
Miscellaneous	—	—	—	—	—	—	—	—	—	—

Total imports of reconditioned machine tools:—Quantity: No., 24; weight, 815cwt.; value, £22,386.

IMPORTS AND EXPORTS (Classified)

and Parts during June, 1958

Threading Machines		Milling Machines		Gear-cutting Machines		Planing, Shaping and Slotting Machines		Presses		Sheet Metal-working Machines		Sawing Machines		Other Machines		Machine Tool Parts*		Total	
Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt.	Value £	Quantity. Cwt. and No.	Value £
—	—	654 (6)	41,047	—	—	—	—	467 (6)	10,530	127 (1)	1,949	—	—	284 (11)	8,820	237	9,280	3,390 (103)	119,348
—	—	424 (8)	18,490	—	—	298 (2)	9,185	3,116 (21)	57,093	660 (1)	7,373	130 (2)	2,892	1,525 (17)	36,867	814	30,104	10,812 (208)	303,848
—	—	59 (1)	2,848	—	—	29 (1)	770	—	—	5 (1)	277	—	—	257 (3)	4,008	29	1,517	577 (21)	15,868
54 (2)	2,837	270 (5)	13,067	—	—	39 (1)	675	2,088 (6)	42,998	— (1)	8	—	—	1,173 (12)	25,117	517	28,299	11,401 (90)	282,491
—	—	27 (1)	250	—	—	26 (4)	672	364 (26)	6,016	—	—	—	—	1 (12)	310	8	1,130	1,023 (98)	27,957
—	—	68 (2)	3,202	—	—	37 (2)	785	916 (10)	17,472	—	—	26 (4)	720	224 (6)	6,929	321	11,888	2,834 (72)	76,811
41 (3)	1,693	7 (1)	362	—	—	178 (4)	3,831	656 (16)	15,363	7 (1)	274	37 (4)	793	213 (24)	4,815	442	4,437	3,838 (206)	103,243
—	—	—	—	—	—	—	—	—	—	—	—	—	—	6 (2)	740	—	—	6 (2)	740
—	—	—	—	245 (1)	10,460	748 (1)	14,140	—	—	2 (1)	115	—	—	—	—	85	5,168	1,664 (18)	58,058
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	872	8,094	1,130 (5)	16,912
—	—	—	—	—	—	—	—	—	—	—	—	—	—	35 (1)	3,399	44	2,179	129 (6)	8,259
—	—	—	—	—	—	—	—	60 (1)	2,782	—	—	—	—	—	—	107	1,875	210 (6)	7,497
—	—	36 (3)	1,327	—	—	69 (4)	1,285	40 (1)	2,488	—	—	12 (2)	245	352 (4)	11,970	27	3,066	968 (35)	35,605
—	—	90 (1)	5,966	—	—	—	—	34 (1)	1,912	—	—	—	—	111 (2)	2,888	90	2,901	357 (12)	14,831
—	—	—	—	—	—	—	—	2,392 (1)	41,018	20 (1)	1,557	—	—	75 (2)	3,298	91	9,100	2,818 (24)	68,823
—	—	—	—	—	—	26 (2)	303	—	—	—	—	—	—	— (1)	33	26	1,508	132 (12)	5,350
—	—	777 (4)	32,196	1,035 (1)	21,541	456 (1)	7,863	1,433 (5)	25,649	45 (2)	1,000	—	—	—	—	168	8,367	4,564 (27)	130,404
—	—	—	—	—	—	—	—	—	—	—	—	—	—	130 (3)	5,321	2,115	32,216	2,338 (8)	43,208
—	—	101 (4)	2,998	—	—	—	—	40 (1)	651	80 (1)	2,200	—	—	67 (9)	3,396	182	13,813	1,774 (45)	75,177
—	—	122 (6)	4,885	—	—	167 (11)	3,664	1,372 (27)	24,642	40 (4)	1,201	86 (8)	1,927	1,689 (21)	20,931	145	7,275	6,760 (276)	169,613
95 (5)	4,530	2,635 (42)	126,638	1,280 (2)	32,001	2,073 (33)	43,173	12,978 (122)	248,614	986 (14)	15,954	291 (20)	6,577	6,142 (130)	138,842	6,320	182,217	56,725 (1,274)	1,564,043
—	—	—	—	—	—	+1251 (−4)	−6,302	—	—	—	—	+76 (1)	+741	+61 (−4)	+1,702	+257	+4,126	—	—
—	—	—	—	+186 (+1)	+8,951	+102 (−1)	−9,763	−230 (−8)	−10921	+4411 (—)	+63558	—	—	+932 (—)	+21854	+166	+264	—	—

Figures in parentheses denote number of machines. * Not including machine tool cutting parts.

and Parts during June, 1958

Other Lathes		Milling Machines		Planing, Shaping and Slotting Machines		Presses and Sheet Metal-working Machines		Other Machines		Machine Tool Parts*		Total	
Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt.	Value £	Quantity. Cwt. and No.	Value £
64 (2)	2,756	838 (18)	34,294	903 (6)	29,910	2,224 (22)	57,036	3,565 (57)	136,278	694	40,352	10,269 (177)	413,588
—	—	40 (1)	2,712	—	—	175 (1)	3,242	19 (2)	678	20	1,220	413 (5)	13,707
81 (3)	2,956	362 (5)	17,045	56 (2)	1,238	—	—	28 (2)	740	97	8,912	1,621 (27)	77,424
—	—	127 (9)	9,713	9 (1)	1,338	349 (2)	9,111	43 (5)	4,787	169	27,560	1,604 (65)	125,653
—	—	—	—	33 (2)	5,832	239 (2)	14,257	2,388 (12)	182,327	1,224	136,902	4,718 (34)	440,153
15 (1)	1,150	195 (4)	6,706	200 (1)	2,776	203 (9)	6,106	290 (7)	8,620	148	11,068	1,654 (46)	61,944
160 (6)	6,862	1,562 (37)	70,470	1,201 (12)	41,094	3,190 (36)	89,752	6,333 (85)	333,430	2,352	226,014	20,279 (354)	1,132,469
—	—	—	—	—	—	—	—	+72 (+3)	+1,681	—	−160	—	—
—	—	—	—	—	—	—	—	—	—	—	−80	—	—
+16 (+2)	+2,397	—	—	—	—	—	—	−16 (−2)	−2,317	—	+97	—	—
—	—	—	—	—	+19	—	—	—	—	+8	+336	—	—
—	—	—	—	—	—	−24 (−2)	−300	—	—	−1	+344	—	—

Figures in parentheses denote number of machines. * Not including machine tool cutting parts.

Association of Engineering Distributors

Mr. T. H. Burleigh, sales director of Firth Brown Tools, Ltd., Sheffield, 4, was the principal guest at the last of the 1958 series of Council Luncheons held by the Association of Engineering Distributors, Ltd., Hastings House, Norfolk Street, London, W.C.2. Speaking on the subject of "Fair Prices and Practices," Mr. Burleigh drew attention to the fact that, probably for the first time in 20 years, there was now a buyer's rather than a seller's market. At the same time there had been a fall in world prices. The situation now, he said, was largely one of too much capacity chasing too few orders, and competition was keen, but the responsibility of both manufacturers and distributors to each other, to their customers, and to the shareholders, must be borne in mind.

The luncheon was followed by a Council Meeting at which the latest report of the Executive Committee was presented. In this report, it was announced that the British Rawhide Belting Co., Ltd., 246 Great Portland Street, London, W.1, and Motor & General Factors, Ltd., Newport, Mon., had recently become members.

Machine Tool Share Market

A good level of activity was maintained in stock markets during the period under review, and in most sections the trend of prices was upwards.

Firmness was displayed by the gilt-edged section, and British Funds, together with other high-grade fixed interest stocks, closed with a general improvement.

Commercial and industrial share markets showed a bright tendency, and although there was some irregularity in price movements, the majority of changes were favourable on balance, and a number of good features was in evidence.

Among machine tool issues, Edgar Allen advanced 3d. to 33s.; Geo. Cohen, 3d. to 10s. 9d.; Coventry Gauge & Tool, 3d. to 16s. 1½d.; Coventry Machine Tool, 3d. to 8s. 6d.; Asquith Machine Tool, 1s. to 20s. 6d.; Arnott & Harrison, 6d. to 15s.; Broom & Wade, 4½d. to 12s. 6d.; Butler Machine Tool, 9d. to 7s. 9d.; Samuel Osborn, 1s. to 21s.; Ambrose Shardlow, 2s. 6d. to 43s.; Thos. W. Ward, 2s. 6d. to 83s. 6d.; Scottish Machine Tool, 6d. to 5s. 6d.; and John Shaw & Sons (Wolverhampton), 6d. to 13s. 3d.

On the other hand, British Oxygen lost 6d. at 39s.; Chas. Churchill, 1½d. at 5s.; Craven Bros. (Manchester), 3d. at 7s. 1½d.; Kayser Ellison, 1s. at 44s.; and Kendall & Gent, 7½d. at 7s.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	9d.
Armstrongs, Stevens & Son, Ltd.	Ord.	5/-	8/3
Allen (Edgar) & Co., Ltd.	Ord.	£1	33/-
" " "	5% Prf.	£1	15/3*xd
Arnott & Harrison, Ltd.	Ord.	4/-	15/-
Asquith Machine Tools Corp., Ltd.	Ord.	5/-	20/6
" " "	6% Cum. Prf.	£1	18/6
Birmingham Small Arms Co., Ltd.	Ord.	£1	31/9
" " "	5% Cum. "A" Prf.	£1	15/6
" " "	6% Cum. "B" Prf.	£1	17/6
" " "	4% 1st Mort. Deb.	Stk.	88½
British Oxygen Co., Ltd.	Ord.	£1	39/-
" " "	6½% Cum. Prf.	£1	21/6
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	3/10½
Broom & Wade, Ltd.	Ord.	5/-	12/6
" "	6% Cum. Prf.	£1	17/9xd
Brown (David) Corporation Ltd.	5½% Cum. Prf.	£1	14/-
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/9
Butler Machine Tools Co., Ltd.	Ord.	5/-	7/9
" " "	5% Cum. Prf.	£1	13/9
C.V.A. Jigs, Moulds & Tools, Ltd.	5½% Red. Cum. Prf.	£1	11/3
Churchill (Charles) & Co., Ltd.	Ord.	2/-	5/-
" " "	6% Cum. Prf.	£1	26/10½
Churchill Machine Tool Co., Ltd.	Ord.	5/-	16/9xd
" " "	6% Cum. Prf.	£1	18/3xd
Clarkson (Engrs.), Ltd.	Ord.	5/-	15/-
Cohen (George), Son & Co., Ltd.	Ord.	5/-	10/9
" " "	4½% Cum. Prf.	£1	14/6
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	16/1½
" " "	5% Cum. Red. Prf.	£1	16/3
Coventry Machine Tool Works, Ltd.	Ord.	4/-	8/6
Craven Bros. (Manchester), Ltd.	Ord.	5/-	7/1½
Elliott (B.) & Co., Ltd.	Ord.	1/-	3/3
" "	4½% Red. Cum. Prf.	£1	13/9
Expert Tool & Case Hardening Co., Ltd.	Ord.	2/-	1/3
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	12/6xd
Greenwood & Batley, Ltd.	Ord.	£1	50/7½
Harper (John) & Co., Ltd.	Ord.	5/-	15/6
" "	4½% Red. Cum. Prf.	£1	12/10½xd
Herbert (Alfred), Ltd.	Ord.	£1	35/7½
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	12/-
" "	"B" Ord.	5/-	11/6
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	23/-
" " "	7% Cum. Prf.	5/-	5/-
Kayser, Ellison & Co., Ltd.	Ord.	£1	44/-
" " "	6% Cum. Prf.	£1	18/3
Kendall & Gent, Ltd.	Ord.	5/-	7/-
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	6/3
Kitchen & Wade, Ltd.	Ord.	4/-	8/3
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/4½
Massey, B. & S., Ltd.	Ord.	5/-	8/3
Modern Engineering Machine Tools Ltd.	Ord.	5/-	10/7½
Newall Engineering Co., Ltd.	Ord.	2/-	4/9
Newman Industries, Ltd.	Ord.	2/-	2/3
" "	6% Prf. Ord.	5/-	5/6
Noble & Lund, Ltd.	Ord.	2/-	3/9
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	21/-
" " "	5½% Cum. Prf.	£1	25/6xd
Pratt (F.) & Co., Ltd.	Ord.	5/-	21/3
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	5/6
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	43/-
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	13/3
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	11/9
" " "	5% Cum. Prf.	£1	15/-
Stedall & Co., Ltd.	Ord.	5/-	6/9
	"B" non-voting Ord.	10/-	20/-
Sykes (W. E.) Ltd.	Ord.	5/-	7/6
Tap & Die Corporation, Ltd.	4½% Deb. 1961-1977	Stk.	82/-
Wadkin, Ltd.	Ord.	10/-	17/6
Ward (Thos.) W.), Ltd.	Ord.	£1	83/6
" "	5% Cum. 1st Prf.	£1	15/6
" "	5% Cum. 2nd Prf.	£1	24/-
Willson Lathes, Ltd.	Ord.	1/-	2/4½

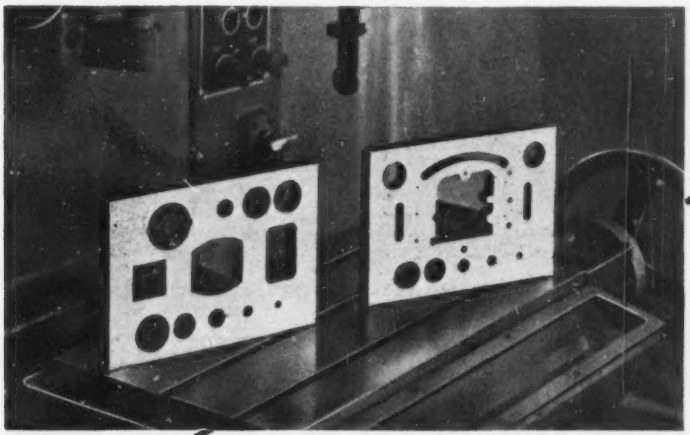
The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. † Birmingham price.

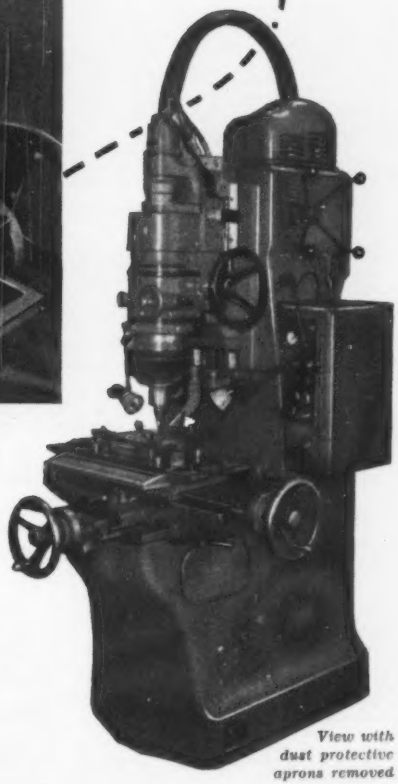
the *Ultimate* in Jig Grinding...

MOORE-CATMUR

NO. 2 PRECISION JIG GRINDER

Samples showing the possibilities of this machine





View with dust protective aprons removed

Designed for the accurate location and grinding of

HOLES
Straight or tapered

CONTOURS
regular and irregular, straight or tapered
Especially suitable for the production of accurate press tools; Table size 10" x 19"

"This machine can save you time and money —ask the man who has one. Users names gladly sent on request."

CATMUR MACHINE TOOL CORPORATION LIMITED

103 Lancaster Road, Ladbroke Grove, London, W.11. 'Phone PARk 9451/2

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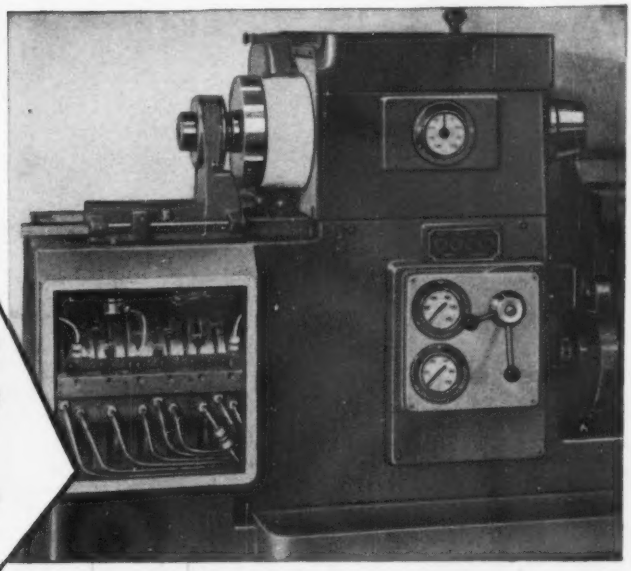


HYDRAULIC CONTROL

for GREATER FLEXIBILITY — GREATER PRODUCTION CAPACITY

BUTTERWORTH

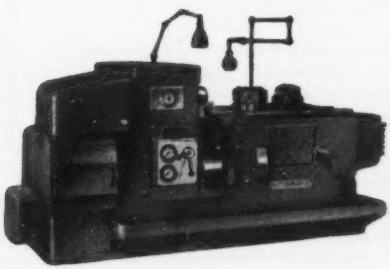
HYDRAULIC AUTOMATIC

cuts costs on short or long runs

• ADVANCED DESIGN • NEW STANDARDS OF PRODUCTIVITY • INFINITELY VARIABLE SPEED CONTROL • NO SPECIAL CAMS

Here is a machine to meet to-day's demand for lower costs. Ample power, combined with foolproof hydraulic control of feed, elimination of special cams, and great flexibility ensure the highest possible production rates, even on small batches. Note, too, the chucking and bar feed are hydraulically operated.

The range of sizes covers work from $1\frac{5}{8}$" to $2\frac{1}{2}$" diameter bar. Hydraulic copy turning attachment and cross slide longitudinal turning attachment available. Other sizes and models include $\frac{7}{8}$" SD, $\frac{7}{8}$"-$1\frac{1}{16}$" SD, $1\frac{1}{4}$" AG, 3" AG and $3\frac{1}{2}$" AG.



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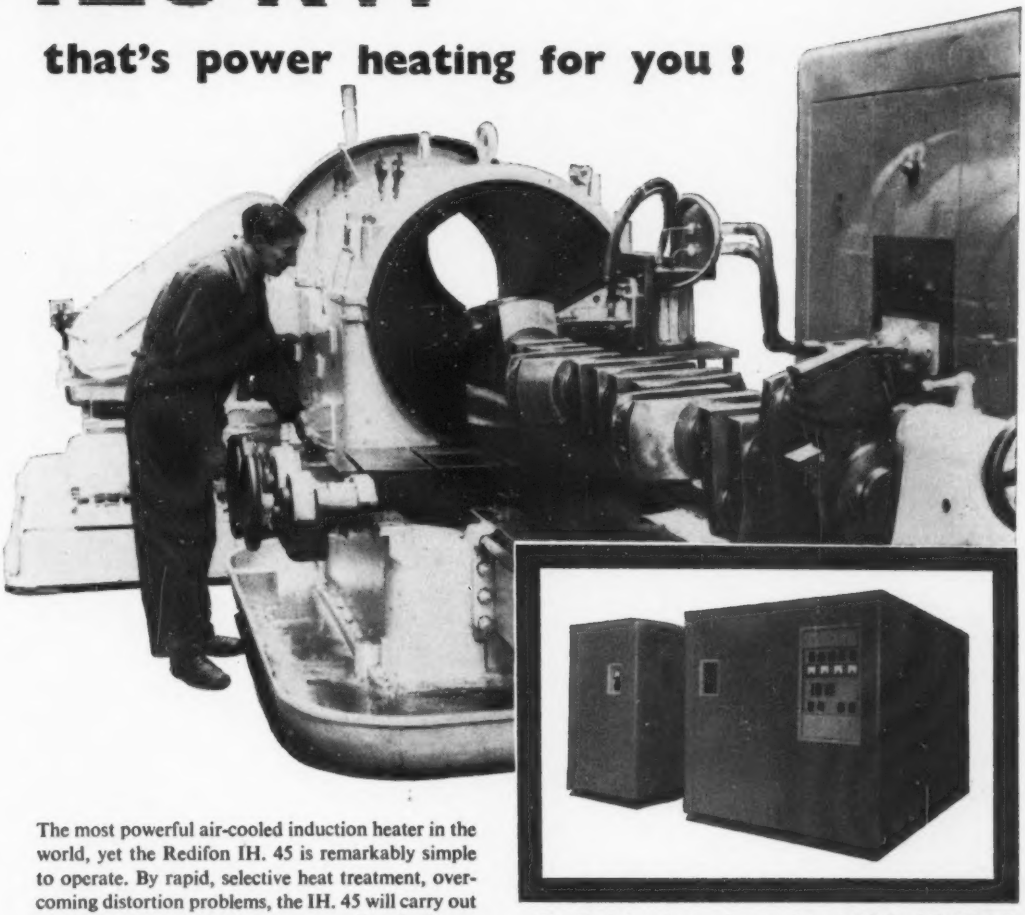
BRITISH AUTOMATIC MACHINE TOOL CO. LTD.

LINCOLN STREET, ROCHDALE

125 kW

that's power heating for you !



The most powerful air-cooled induction heater in the world, yet the Redifon IH. 45 is remarkably simple to operate. By rapid, selective heat treatment, overcoming distortion problems, the IH. 45 will carry out a wide variety of heating processes. Speed of production is greatly increased; processing time reduced to a fraction of that needed by other methods. This heater provides 7000 B.Th.U. of process heat per minute, with a power output—continuously variable from 3 kW to 125 kW—operated from a single control. Compactly designed to fit into the factory layout, the IH. 45 will give reliable, continuous service under the most arduous conditions.

The illustration shows a large marine crankshaft which Mitchell-Shackleton & Co. Ltd. are heat-treating for one of their customers.

Redifon IH 45

REDIFON LIMITED Industrial Electronics Division, Broomhill Road, London S.W.18
Telephone: VANdyke 7281

A Manufacturing Company in the Rediffusion Group.

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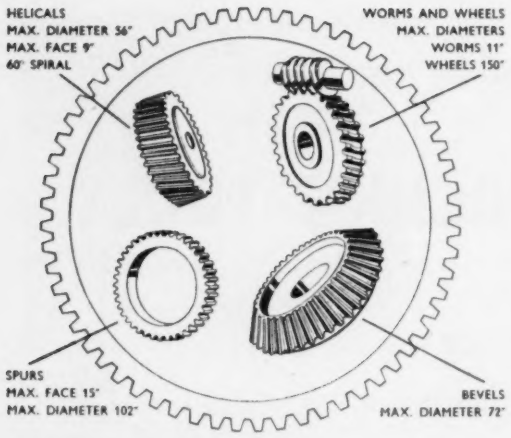

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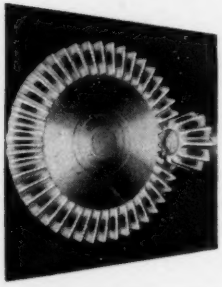
YOUR ENQUIRIES ARE INVITED

COMPETITIVE PRICES

GOOD DELIVERY



Precision straight tooth bevel gears with **LOCALISED TOOTH BEARING**

Capacity
Mitres: 25" dia.
Bevels: up to 35½" dia.
Maximum pitch: 1½ D.P.

CAMPBELLS & HUNTER LTD

SAYNER ROAD, LEEDS 10.

Tel: Leeds 22397. Grams: Dolphin, Leeds 10.

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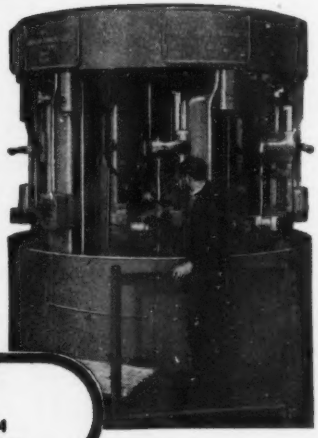
110 Seconds for these 3 Splines

– at Austin Motor Co. Ltd on the LEES-BRADNER 6-SPINDLE ROTARY HOBBER



The latest 7-HD is a heavy duty machine with either 4 or 6 spindles. The automatic cycle is electrically controlled and hob shift is automatic. Automatic loading and unloading can be be arranged for suitable work. For spurs, helicals and splines. Up to 8" diameter, 20" Face, 4 D.P.

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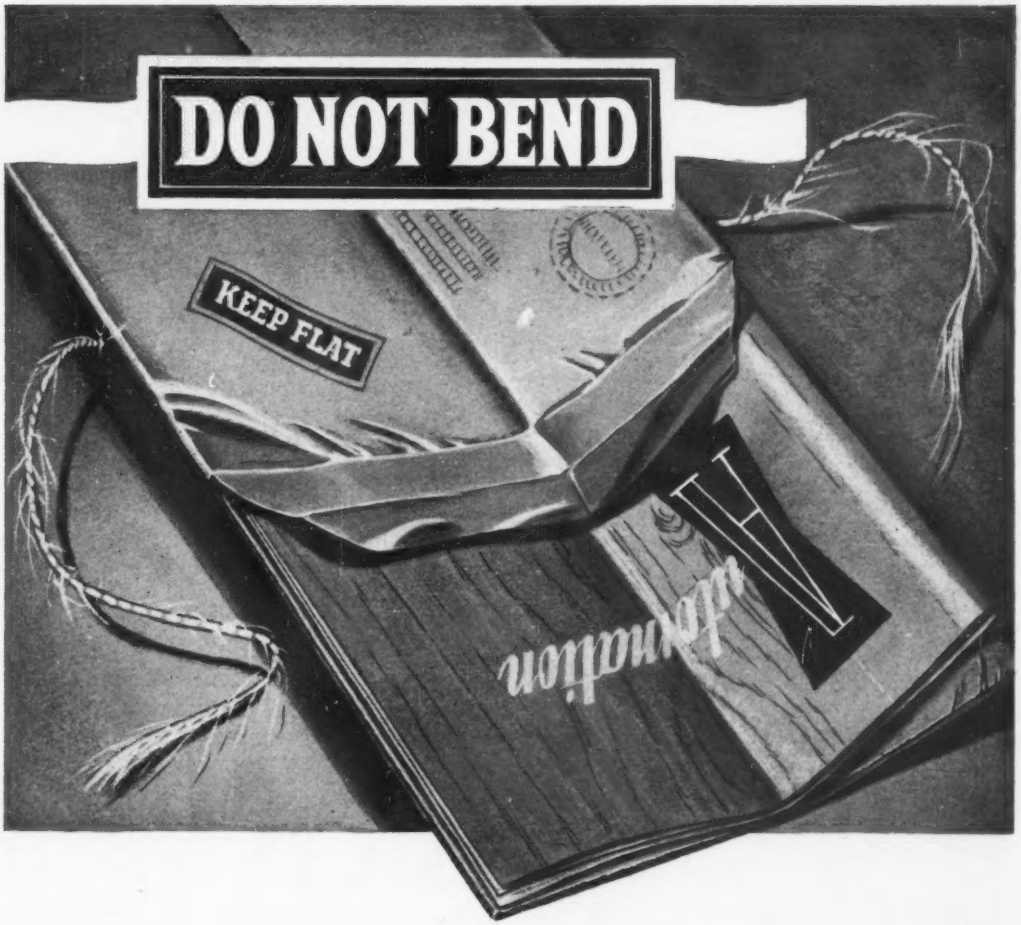

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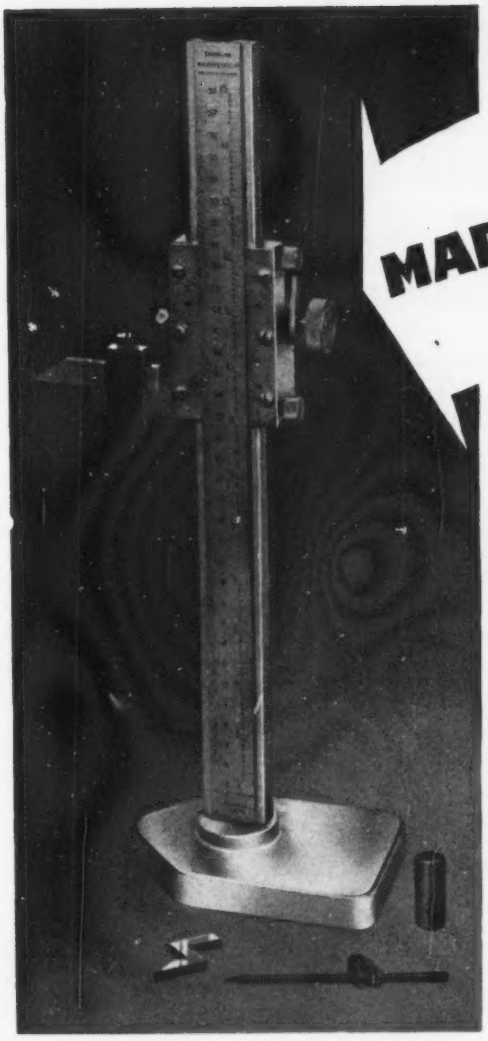

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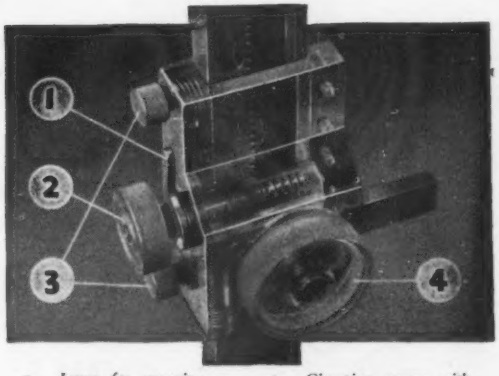
. . . MORE RAPIDLY

Flush fitting vernier scales to **eliminate parallax** thus avoiding errors of setting and reading.

Sliding vernier head has rapid traverse with geared fine movement for final setting.

Exceptionally clear graduations and matt chrome finish ensure easy and accurate reading under all lighting conditions.



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4. *Rapid traverse knob.*

Supplied complete with scriber, offset scriber for zero reading, hardened rod for depth measurements, and 2in. gauge block, complete in hardwood case. Additional accessories for clamping indicators are also available.

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MODEL	ENGLISH	METRIC
1000	12in.	320 m/m
1001	18in.	470 m/m
1002	24in.	620 m/m

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VERNIER HEIGHT GAUGE
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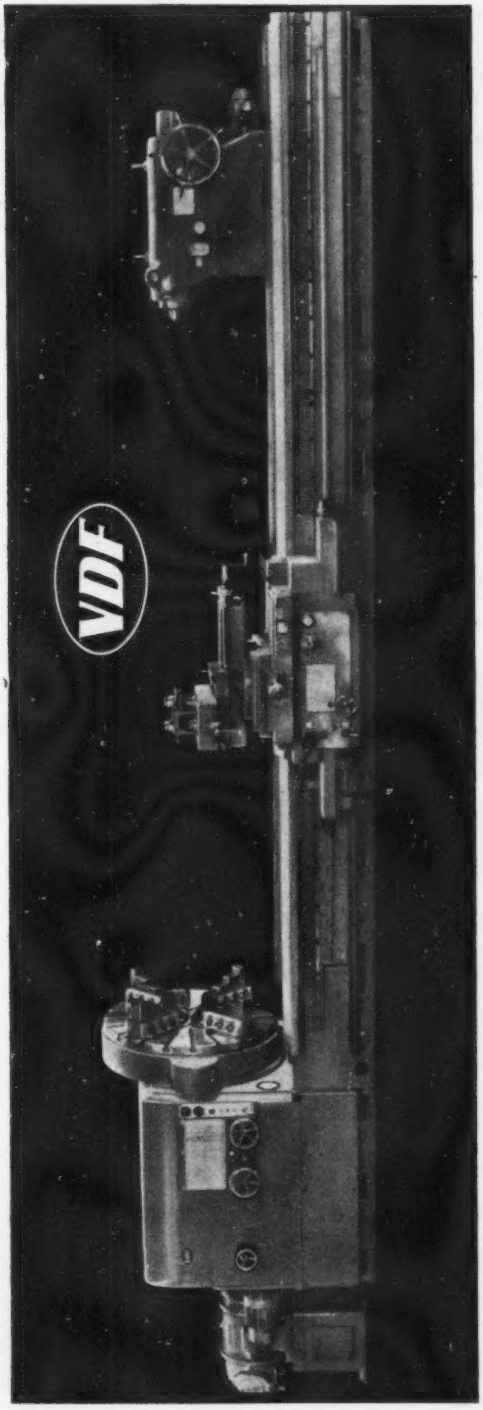

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- extremely rigid construction gives smooth turning at high cutting speeds.
- 24 spindle speeds, up to 180 r.p.m.
- headstock spindle carried on three double-row precision roller bearings.
- entire feed drive controlled from operator's position on saddle.
- rapid traverse of saddle 10 ft. per min. Brake fitted.
- safety devices ensure against incorrect engagement of sliding gears, failure of oil circulation or overloading.

BRIEF SPECIFICATION

height of centres	up to 41½"
swing over bed	up to 81"
centre distance	up to 394"
speed range—r.p.m.	0.9 —180
	0.56—112
no. of speeds	24
motor capacity	up to 100 h.p.

Sole British Agents

SYKES

Machine Tool Co. Ltd

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Staines, Middlesex
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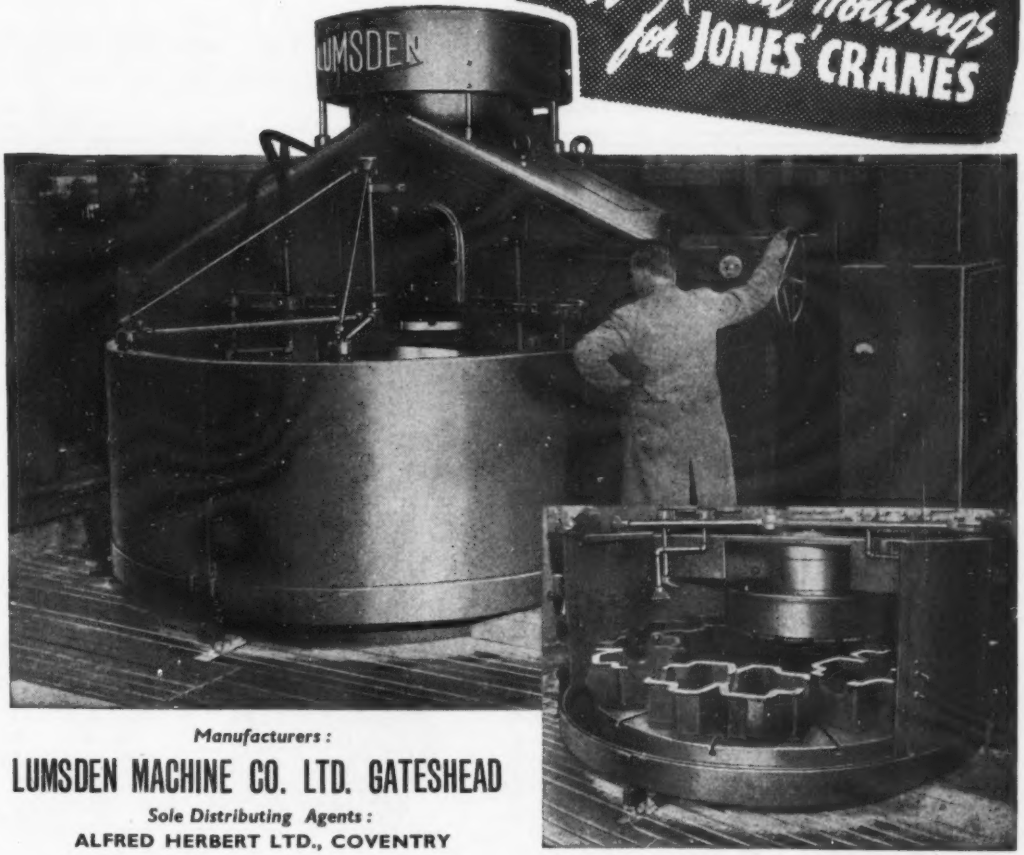
Staines 5076 (3 lines)
Telegrams Sytool Staines

LUMSDEN MODEL 96 LM SURFACE GRINDERS

Top rates of production are linked with a high order of accuracy when 12 cast steel gear housings for the Jones KL66 crane pass under an 18-piece segmental wheel on this model 96 LM Heavy Duty Surface Grinder. The large diameter table revolves at 8 R.P.M. $\frac{1}{16}$in. of metal is removed and the components are sized to +0·002in. Whilst the Lumsden model 96LM is designed to tackle just such a job as this, in the most rapid, precise and economical manner possible, a complete range exists, from which to choose a machine ideally suited to your own grinding requirements.

Close limits and high Output on Differential Housings for JONES' CRANES



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Capacity shortly available for:—
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(Max. O.D. 5in. Min. D.P. 120)
Bore/P.D. Concentricity ·0005"
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(Up to 1¾in. dia. by 2½in. long)
(Over 1¾in. dia. by 4½in. long)
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Max. capacity 12 D.P. 8in. dia
Blanks turned and cut.
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Silence	33⅓ per cent. higher loads.
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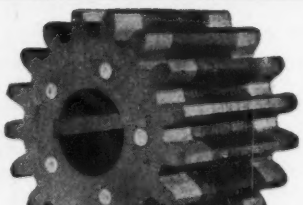

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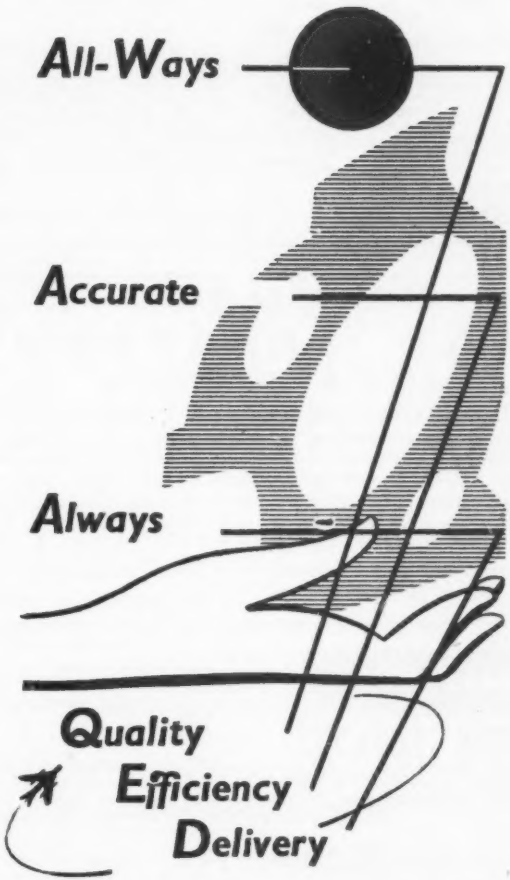

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WILLSON Mark V 7½in. by 48in., S.S. & S.C. Gap Bed Lathe, admits 48in., speeds 54 to 954 r.p.m. and 37 to 739 r.p.m. NEW.

DEAN SMITH & GRACE Type "A" 7in. by 31in. S.S. & S.C. Gap Bed Centre Lathe, speeds 11 to 490 r.p.m. Serial No. 21303.

REIDEN 7½in. by 40in. S.S. & S.C. Gap Bed Toolroom Lathe, fitted taper turning attachment, pump, 3-jaw chuck, speeds 25 to 1,350 r.p.m. NEW.

MITCHELL 6½in. by 64in. S.S. & S.C. Gap Bed Centre Lathe, taper turning attachment, speeds 27 to 400 r.p.m. Nearly New.

STUDENT 6in. by 24in. S.S. & S.C. Gap Bed Lathe, speeds 52 to 1,000 r.p.m. NEW.

THIS WEEK'S SPECIAL

KEARNS
No. 5 Horizontal Borer, 6in. diameter travelling spindle, facing chuck 5ft diameter, vertical traverse 7ft. 6in., longitudinal 12ft. 6in. Admits between spindle and outer support 18ft 6in. Built 1955.

Two **CINCINNATI**
3P Dial Type Plain Horizontal Milling Machines. Built 1955.

HARRISON Model L.6 11in. swing by 22in. between centres S.S. & S.C. Lathe, fitted with copying attachment. Sixteen spindle speeds 45 to 2,000 r.p.m. NEW.

WILLSON Mark I 6½in. by 24in. Sloping Bed Type Lathe, speeds 52 to 954 r.p.m. NEW.

DRILLING MACHINES

ASQUITH 9ft. 0in. Elevating Arm Radial Drilling Machine.

RICHMOND S.R.2 36in. Radial Drill, elevating table, suds pump. NEW.

JONES & SHIPMAN 30in. Model 921, 2-spindle Manufacturing Drilling Machine. 1½in. capacity, speeds 39 to 825 r.p.m. Table 42in. by 24in.

PROGRESS 3A Pillar Drilling Machine, Circular table. NEW.

GRINDERS

NORTON 10in. by 36in. Hydraulic Horizontal Spindle Surface Grinder, fitted "Humphries" chuck. Toolroom condition.

BROWN & SHARPE No. 5 Hydraulic Horizontal Spindle Surface Grinder, capacity 24in. by 8in. by 11in.

BURDETT Hydraulic Horizontal Spindle Surface Grinder, capacity 18in. by 6in. by 10in. NEW.

LANDIS Hydraulic Universal Grinder, type "C", capacity 10in. by 24in. Serial No. 27916.

MYFORD M.G.12 Plain Cylindrical Grinder, capacity 5in. by 12in. NEW.

CHURCHILL HBA Automatic Internal Grinder. Wartime built.

NEWALL Hydraulic 10in. by 36in. Plain Cylindrical Grinder. Wartime built.

MILLING MACHINES Vertical

CINCINNATI No. 4 Dial Type Vertical Milling Machine, table 78½in. by 16½in. rapid and power traverses 42in. by 16in. by 16in. Speeds 18 to 1,300 r.p.m. British built 1955.

Universal

VICTORIA U.2 Universal Milling Machine, table 45in. by 11in., power feeds 29½in. by 65in. by 16in., speeds 30 to 1,010 r.p.m. NEW.

RICHMOND No. 3 Universal Milling Machine, table 48in. by 11in., rapid and power traverses 30in. by 8in. by 16in., speeds 20 to 1,000 r.p.m. NEW.

DENBIGH C.4 Universal Milling Machine, table 46in. by 10in., automatic longitudinal feed 36½in., speeds 13 to 400 r.p.m. NEW.

Horizontal

CINCINNATI No. 3P Plain Horizontal Milling Machine, table 62½in. by 15½in., power and rapid traverses 34in. by 12in. by 20in. Speeds 18 to 450 r.p.m. British built 1955.

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Cashmores

Selection of Machine Tools from Stock

CENTRE LATHES

New MITCHELL OF KEIGHLEY 8½in. S.S. & S.C. Lathe, to admit 4ft. 3in. between centres.
New MITCHELL OF KEIGHLEY 12½in. S.S. & S.C. Lathe, to admit 8ft. 9in. between centres.
New MITCHELL OF KEIGHLEY 10½in. S.S. & S.C. Lathe, to admit 7ft. 5in. between centres.
LANG 6½in. S.S. & S.C. Lathe, to admit 2ft. between centres
New COLCHESTER TRIUMPH 7½in. S.S. & S.C. Lathe, cabinet base to admit 4ft. between centres.
LANG 8½in. S.S. & S.C. Lathe, to admit 4ft. 0in. between centres.
COLCHESTER MASCOT 8½in. S.S. & S.C. Lathe, to admit 4ft. 6in. between centres.
VOLMAN 8in. S.S. & S.C Gap Bed Lathe, to admit 4ft. 6in. between centres.
F.L.C.B. 13in. S.S. & S.C. Heavy Duty Lathe, to admit 17ft. between centres, 2 saddles.

CAPSTAN LATHES

WARD 3A Capstan Lathe, with collet chuck and bar feed, 1¼in. capacity.
WARD 2A Capstan Lathe, with collet chuck and bar feed, 1¼in. capacity.

BORING MACHINE

TULLIS Horizontal Boring Machine, Floor Type with 3½in. traversing spindle, 9ft. 0in. by 2ft. 6in. tee-slotted baseplate.

DRILLING MACHINES

PROGRESS 4E Pillar Drilling Machine, No. 3 M.T. spindle. New and used available.
New RICHMOND SR2 36in. Sensitive Radial Drilling Machine.

MILLING MACHINES

HERBERT 23V Vertical Milling Machine, 68in. by 17in. table.
CINCINNATI No. 3 Dial Type Vertical Milling Machine, 62½in. by 15in. table, motorised.
ARCEDALE 18in. Vertical Milling Machine, 38in. by 10in. table.
CRAVEN "Rigidmill" Production Milling Machines, working surface of table 39in. by 13in., spindle speeds 25-400 r.p.m. Two machines available.
EDGWICK 18in. Production Milling Machine working surface of table 26in. by 12in.
New VICTORIA U1, U2 and U3 Universal Milling Machines.
ARCHDALE 20in. Horizontal Plain Milling Machine, 40in. by 10in. table.
CUTTAT HYPERMIL Production Milling Machine, 43in. by 10in. working surface of table, with 4 automatic cycles to table.

SAWING MACHINES

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NOBLE & LUND 11/16in. Cold Circular Sawing Machine.

SHEARING MACHINE

RUSHWORTH 10ft. 0in. by ¼in. Overcrank Guillotine Shearing Machine.

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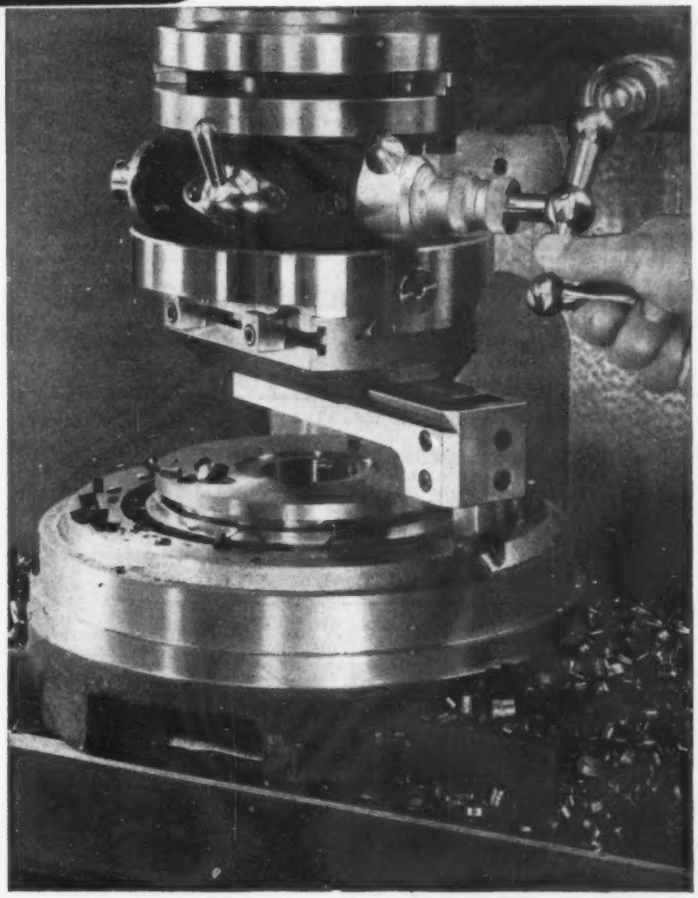

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Besco 5ft. × 14G Power Guillo- tine, motorised, 400-440 volts, 3-phase, 50 cycles. Four Lecra 4ft. × 14G Power Guillotines, motorised 400-440 volts, 3 phase, 50 cycles.—BOX Z462, MACHINERY, Clifton House Euston Road, N.W.1.

Churchill Centreless Grinder, type E.C., up to 6in. capacity. Motorised 400/3/50. In first-class condition. Offers.—BOX Z463, MACHINERY, Clifton House, Euston Road, N.W.1.

Jones & Shipman Hydraulic Surface Grinder. Model 540. Capacity 6in. × 18in. Motorised.—WILCOX & CO., Barr Street, Birmingham 19. NORthern 1234/5.

A.1 type RA16 Spot Welding Machine for sale. Rated capacity 16 kVA. Welds two thicknesses of 10 S.W.G. mild steel using 16in. arms or two thicknesses of 16 S.W.G. using 24in. arms. Automatic timing device. Automatic forging interlock. Suitable for 400-440 volts, 50 cycles.—Full details from F. J. EDWARDS LIMITED, 359, Euston Road, London, N.W.1. EUSton 4681, or 41, Water Street, Birmingham 3. Central 7606/7.

New Brook and Newman 3 phase, 1 h.p., ¾ h.p. and ½ h.p. motors at list less 40 per cent.—A. B. BLANCH & CO., LTD., Crudwell.

Classified Advertisements (*PLANT FOR SALE, contd.*)

RING BELLS for machine tools

LEEDS 63-7398

Herbert 3A Auto. Motorised 400/3/50.—ALBERT EDWARDS (MACHINERY), LTD., 79/89, Pentonville Road, London, N.1. 'Phone: Terminus 0167/8/9.

Asquith 4ft. 6in. Radial, Model O.D.1., Town 4ft. Radial, Model A.E.1; Archdale 3ft. 6in. Radial, 1948 machine; all two motor type with loose box table.—BOX Z478, MACHINERY, Clifton House, Euston Road, N.W.1.

Taper Turning Lathe, Production or cock plugging type, Taylor post war cabinet, Mot., machine. Excellent condition. C. L. THOMAS, LTD., 18, Park Avenue, Solihull 1281.

Kerry 125 (New) Pillar Drilling Machine, 1¼in. capacity, power feed. Motorised 400/3/50.—SOUTHERN ENGINEERING & MACHINERY CO., Connaught Buildings, Tanners Brook, Millbrook, Southampton. Tel.: Southampton 73101.

Herbert No. 1 Capstan Lathe, serial 29-389, complete with 1in. capacity dead length collet chuck, range of collets, barfeed, electric coolant pump, etc., self-contained machine 400/3/50 in very good condition, spindle speeds 57 to 4,020 r.p.m. £165.—E. SMITH (MACHINE TOOLS), LTD., 76, St. Lukes Road, Birmingham, 5. TEl.: CALthorpe 3761.

New "Norton" 40-Ton Inclinable, open fronted Power Press; adjustable stroke ⅛in. to 3⅛in.; top ejector, automatic lubrication; full electrical equipment, 5 h.p. motor. Price: £1,030 0 0 complete.

CHARLES E. MATTHEWS (MACHINE TOOLS), LTD.,
Gladstone Road,
Croydon, Surrey.
Tel.: THOrnton Heath 1783.

CINCINNATI No. 4 Dial type Plain Milling Machine, table area 78in. × 16in. Rapid traverse, 16 spindle speeds 18-450 r.p.m. 16 auto. feeds, elec. suds and fittings. 400/3/50. S.N. 3863.

ARCHDALE 30 VM Vertical Milling Machine, table area 54¼in. × 14¼in., 12 spindle speeds 29-522 r.p.m. Spindle bored No. 50 INT, 9 auto feeds, elec. suds and fittings. 400/3/50. S.N. C145.

BINNS & BERRY Type TB, 12¼in. Centre Lathe, 12ft. bed, 16 spindle speeds 12-600 r.p.m. Hole thro' spindle 4in. dia. 12½ h.p. motor drive, 400/3/50. New machine.

CHURCHILL REDMAN 24 ND Surfacing and Boring Lathe, 12in centres × 50in. between, swing in gap 38in. dia. Full range screwcutting, 16 spindle speeds 14-408 r.p.m. Hole thro' spindle 3⅛in. dia. 400/3/50 (as new). S.N. 3703.

WARNER & SWASEY 2A Universal Turret Lathe, max. swing over covers 20in. dia. Hole thro' spindle 3⅛in. dia. 12 spindle speeds 67-860 r.p.m. Rapid traverse 400/3/50. S.N. C134.

BRONX Series 68 60-ton Press Brake, 8ft. × ⅛in. cap. Ser. No. 30549, stroke 3in., throat 9in., 400/3/50. S.N. C159.

RHODES 218 Geared, Inclinable Power Press, 60 ton pressure, 3½in. stroke, bed area 30in. × 22in., centre to back 9in., tie rods, fully guarded. 400/3/50. S.N. 3941.

U.V.A. Type 195 Automatic Internal Grinding Machine. Max. swing over bed 17in. dia. complete. 400/3/50. S.N. C147.

WICKMAN 5 spindle, 6in. cap. chucking Auto. Ser. No. 450488, complete with air operated chuck, excellent condition. 400/3/50. S.N. C78.

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NILES 48in. Boring Mill, belt-driven, 2 swivelling toolholders, low price for quick sale. £185.

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Blankholder 6ft. by 5ft. with self-contained Pumping Unit

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Replant Works,
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Telephone: WOOlwich 7611/6

No. 2 "Kearns" Patent Horizontal Boring Machine with 3in dia. traversing spindle. Automatic facing head, 30in. cap. Main table 48in. × 30in. Top table 36in. × 36in. 24 spindle speeds. 10 h.p. 400/3/50 motor.—LEE & HUNT, LTD., Crocus Street, Nottingham.

AUCTION

By Order of the DIRECTORS of Messrs. PLANLOC ENGINEERING LTD., following disposal of the Property.

Messrs.

FULLER HORSEY Sons & Cassell

have been instructed to offer for SALE by AUCTION in Lots on the Premises, TUDOR WORKS, CHERTSEY ROAD, BYFLEET, SURREY, on TUESDAY, 7th October, 1958 at eleven a.m. precisely.

MODERN ENGINEERS' MACHINE TOOLS (Near New Condition)

including 5 Grob FINE BORING, TAPPING, DRILLING and CYLINDER BORING MACHINES; Lund Precimax FINE BORING MACHINE; 3 Sykes GEAR GENERATING MACHINES; C.V.A.-Milwaukee VERTICAL MILLING MACHINE, Edgwick 50in. HORIZONTAL BROACHING MACHINE, Drummond Maximinor MULTI TOOL LATHE, Herbert and Ward CAPSTAN LATHES, 2 Herbert CHUCKING AUTOS, Lumsden SURFACE GRINDER, 3 Keighley INTERNAL and PLAIN GRINDING MACHINES, Newall PLAIN GRINDING MACHINE, Scrivener CENTRELESS GRINDING MACHINE, 4 B.S.A. AUTOMATIC SCREW MACHINES, 2 Centec MILLING MACHINES, Herbert PLAIN MILLING MACHINE, Myford and Hendey S.S. & S.C. LATHES, Cincinnati CUTTER GRINDING MACHINE, Abwood TOOL GRINDING and LAPPING MACHINE, Herbert DRILLING MACHINES, Archdale RADIAL DRILLING MACHINE, Steinle Thread Rolling Machine, Delapena Honing Machine, Phillip Universal Clarifier, 3 Lincoln Welding Generators, Quasi-Arc Welding Transformer, Testing Machines, Fine Tools, Milling and Gear Cutters, Reamers, Twist Drills, Grinding Wheels, etc., Steel Racking, Steel Benches, Canteen Equipment, Drawing Office Equipment, Typewriters, Steel Filing Cabinets, Office Furniture and numerous other effects.

Catalogues, when ready, may be had of Messrs. FULLER HORSEY SONS & CASSELL, Industrial Auctioneers and Valuers, 10, Lloyds Avenue, London, E.C.3.

29th SALE.

By Order of the E R Minister of Supply.

CENTRAL ORDNANCE DEPOT, BICESTER, OXON.

IMPORTANT SALE BY AUCTION BY

MIDLAND MARTS LIMITED

of

GOVERNMENT SURPLUS GENERATORS, CHARGING SETS, MACHINE TOOLS, GENERAL STORES,

VEHICLE, WIRELESS AND SIGNAL SPARES, VEHICLES TYRES, AND TRAILERS, including:

Caterpillar, Lister and Aberdale Generating Sets, M.B.M. Charging Sets, Lathes, Circular Saws, Air Compressers, Aveling Barford and other Road Rollers, Concrete Mixers, Decauville Trucks, Electric Overhead Gantrys, Sewing Machines, Radial Drilling Machines, Tar Heaters and Sprayers, International Track Rollers, Coventry Climax Engines, etc.,
which will be sold in large and small lots to suit all buyers on

TUESDAY AND WEDNESDAY, 14th AND 15th OCTOBER, 1958,
at 11 a.m. on each day.

VIEW DAYS: Thursday, Friday and Monday, 9th, 10th and 13th October.

CATALOGUES, price 1s., to admit two to view and one on sale days, from the Auctioneers (Dept. 8), Market Square, Bicester, Oxon. (Tel. 73).

SITUATIONS VACANT

If you do not wish your reply to any Box No. advertisement in this section to be forwarded to certain firms, please advise us. Your reply will then be destroyed, but you will not be notified as this would disclose the identity of the advertiser.

WALTER SPENCER & CO., LIMITED,

CRESCENT STEEL WORKS, WARREN STREET, SHEFFIELD 4.

REQUIRE:

ASSISTANT MANAGER for their **SMALL TOOLS DEPARTMENT,** producing Milling Cutters, Reamers, Form Tools, Hobs and Broaches.

We are seeking a fully experienced and qualified man between the ages of 30 and 45 years who is a strict disciplinarian, capable of controlling labour and the design, planning and actual shop production of the above range of Cutting Tools. Experience in the design and production of Class AA Hobs would be an especial recommendation.

The position is a responsible and progressive one and successful applicant would eventually be promoted and would have full charge of all Small Tool productions.

Applicants are requested to give very full and specific information of their experience, qualifications, age and other relevant details with a history of their last 10 years' employment and present earnings.

Superannuation and Profit Bonus Scheme.

Tool Maker Required for Press Tool Maintenance, Setting and Production Supervision, in small shop. Assistance with housing can be arranged.—Write, or telephone for application form, to C.I.C. ENGINEERING, LTD., Excalibur Works, Castle Cary, Somerset. Tel.: Castle Cary 434.

Manager (30-45) for Medium sized press shop, Slough area. Must have drive and initiative. Organising ability can outweigh technical qualifications. Excellent salary.—BOX Z459, MACHINERY, Clifton House, Euston Road, N.W.1.

LONDON COUNTY COUNCIL.

Paddington Technical College, Grade B, to teach Engineering Workshop Practice, Technology and Science to Final C and G level to machine shop and engineer-trade apprentices.

H.N. Certificate or equivalent required with good industrial experience in mechanical engineering.

Burnham F.E. salary scale £650 by £25 to £1025 plus London allowance and additions for training and qualifications; increments within salary scale for experience.

Application forms from SECRETARY AT COLLEGE, Saltram Crescent, W.9, to be returned by October 18, 1958. (1783)

Highly Paid Secure and Interesting posts are always available for technically trained men. Find out how you can put some letters after your name by preparing at home in "No Pass—No Fee" terms for A.M.I.Mech.E., A.M.I.Prod.E., A.M.S.E., City and Guilds, etc., etc. Full details of exams. and hundreds of courses in all branches of Engineering, Draughtsmanship and Management, the benefits of our Employment Dept., and unique record of 95 per cent. successes, are given in "Engineering Opportunities"—valuable 144-page Guide which will reveal many chances you are now missing. Write for your copy today (stating subject of interest) —FREE and without obligation.—B.I.E.T., Dept. 34a, Wright's Lane, London, W.8.

N.W. London firm manufacturing precision equipment require a planning and production engineer aged between 30 and 40. Applicant must have experience in small batch production and single spindle auto layouts. Only top rate men capable of holding down a four figure salary need apply.
Box Z 425, MACHINERY, Clifton House, Euston Road, N.W.1.

Working Foreman Required by small progressive engineering firm in N. Essex town. Must have knowledge of Petermann autos, capstans, small presses and able to make tools for same and handle skilled and unskilled labour. Present prospects hard work, future prospects promotion and security. Help will be given with housing.—Write giving full particulars, BOX Z428, MACHINERY, Clifton House, Euston Road, N.W.1.

Draughtsmen. Special Purpose Machine Design and/or Jig and Tool Design Draughtsmen required. Interesting work in good light office. Good rates paid.—Write in first instance to: REVILL DESIGNS LTD., 5, Fenchurch Street, London, E.C.3.

Engineer Required for Expanding works near Swansea to assist Chief Engineer primarily with design of sheet metal forming machines but experience of planning layouts and production sheet metalwork essential. Salary £1,250 upwards, according to experience.—Write in fullest detail to BOX Z461, MACHINERY, Clifton House, Euston Road, N.W.1.

Toolroom Manager Required for medium-sized Trade Shop in Slough area. Similar previous appointment essential. Must be efficient organiser. Knowledge of medium auto body dies an advantage.—BOX Z458, MACHINERY, Clifton House, Euston Road, N.W.1.

Planning Engineer Required by N.W. London Engineers engaged on small batch production of television equipment. Practical background essential, ratefixing ability desirable. Permanent progressive post offered to successful applicant.—BOX Z457, MACHINERY Clifton House, Euston Road, N.W.1.

REPRESENTATIVES

GASTON E. MARBAIX Ltd.
require
SALES ENGINEERS
For the following districts: **London, Midlands, Yorkshire, North-East Coast, Scotland.** Sound engineering background, Machine Tool Sales experience and connections in territory concerned essential. Apply in writing to: **Mr. P. A. Pointer, Director, Devonshire House, Vicarage Crescent, London, S.W.11.**

FREELANCE AGENTS required on commission basis in all areas, by well established Light Engineering Company, situated in South Yorkshire. To obtain work for Machine Shops. A.I.D. approved. All replies treated in strictest confidence.
BOX Z 475 MACHINERY, Clifton House, Euston Road, N.W.1

Freelance Agents Required for the sale of well-introduced machine tools and workshop equipment, in all areas except Birmingham and Yorkshire. Liberal commission and mileage allowance. Workshop experience required, car owner preferred.—BOX Z445, MACHINERY, Clifton House, Euston Road, N.W.1.

Gauge Manufacturers with a new product receiving wide technical publicity urgently require Agents in the North of England and Scotland to expand existing and growing business. Excellent prospects for first class men with connections in precision engineering.—BOX Z456, MACHINERY, Clifton House, Euston Road, N.W.1.

Representatives Wanted to Sell Horizontal Bandsaws, for cutting off sections, joists, tubes, etc., and accurate blanks in M.S. and H.S. steel. Areas: London, Southern Counties, West Country, South Wales.—BOX Z464, MACHINERY, Clifton House, Euston Road, N.W.1.

Agent Required by Ironfounders and Engineers for sale of grey iron castings from loose patterns, up to three tons, and plated patterns. Facilities for suitable machining and light engineering products available. Area mainly outer London and Home Counties. Established connection an advantage. Commission and expense allowance.—Details to BOX Z474, MACHINERY, Clifton House, Euston Road, N.W.1.

Wanted, Free-Lance Representative for Scotland. Precision Engineering Company engaged on Batch Production and situated near Birmingham requires practical man with complementary lines to work on a Commission basis North of the Border.—BOX Z472, MACHINERY, Clifton House, Euston Road, N.W.1.

SITUATIONS WANTED

Mechanical Designer. Experienced in special purpose machines, general tooling, industrial gas turbines, aero engines, automotive design, etc. Formerly Chief Draughtsman, recently returned from U.S.A. Desires position in machine design.—BOX Z442, MACHINERY, Clifton House, Euston Road, N.W.1.

Senior Production Planner (39) with practical tool design experience in aero engines and other precision mechanisms. Ability to organise. Sales experience. Residence Central London.—BOX Z467, MACHINERY, Clifton House, Euston Road, N.W.1.

Planning Engineer (36), Resident Surrey. 20 years' experience, precision machining, tooling, production, planning, liaison. Adaptable organiser. Will consider all interesting offers from progressive firms.—BOX Z468, MACHINERY, Clifton House, Euston Road, N.W.1.

Works Manager, 39, Wishes to change. 25 years' experience light engineering including toolroom, drawing office, production control, work study on fine optical and special purpose machines, jigs, fixtures, press tools, plastic moulding, electro mechanical and electronic devices.—BOX Z367, MACHINERY, Clifton House, Euston Road, N.W.1.

Engineer (46), Administrative grade, seeks supervisory position. Indentured apprentice. Positions held: Production Shop Foreman, Toolroom Foreman, Planning and Methods. Production Development Engineer. Present salary £1,025. (Own mobile home.)—BOX Z349, MACHINERY, Clifton House, Euston Road, N.W.1.

Chief Inspector, A.I.D., A.R.B. Approved, seeks change as C.I. or Works Manager. Matured technical and practical experience production and toolroom.—BOX Z451, MACHINERY, Clifton House, Euston Road, N.W.1.

Manager, D.O., Toolroom, Production Shops, seeks similar position. Experienced on design, mass production of special purpose machines, specialised instruments, presswork, plastics, jigs and fixtures.—BOX Z450, MACHINERY, Clifton House, Euston Road, N.W.1.

REPRESENTATIVES

Technical Sales Representative, age 30 years. Trained engineer, requires position with machine tools or small tools manufacturer. Present living Midlands.—BOX Z434, MACHINERY, Clifton House, Euston Road, N.W.1.

Young Man Aged 26, with Engineering and drawing office experience, seeks position as technical representative in Southern England.—BOX Z449, MACHINERY, Clifton House, Euston Road, N.W.1.

Free Lance Agent, London, S.E. England area, with large turnover in Continental machine tools, seeks sound agencies for jigs, fixtures, standard and special-purpose machine tools to treble present figures.—BOX Z452, MACHINERY, Clifton House, Euston Road, N.W.1

RECEIVED TOO LATE FOR CLASSIFICATION

PLANT WANTED

Wanted, Electrically Heated press platens, 20in. × 20in.—BOX Z477, MACHINERY, Clifton House, Euston Road, N.W.1.

A Secondhand Taylor Hobson or David Dowling Engraving Machine required for engraving characters between ¼in. and ⅛in.—Full details to BOX Z476, MACHINERY, Clifton House, Euston Road, N.W.1.

Wanted.—Spare Crankshaft for Taylor & Challen B3½ Press.—HICKS MACHINERY LTD., 26, Addison Place, London, W.11. Tel.: PARk 2333.

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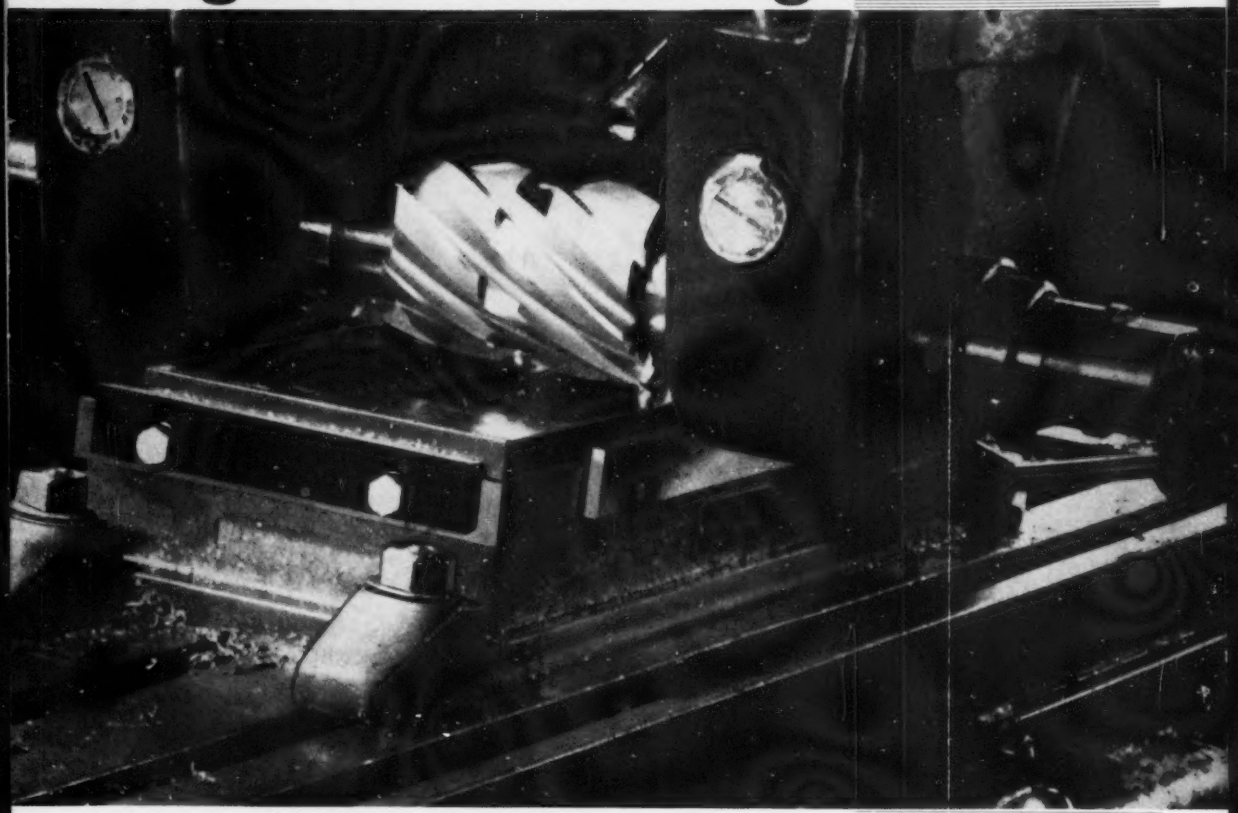
magnetic chucking



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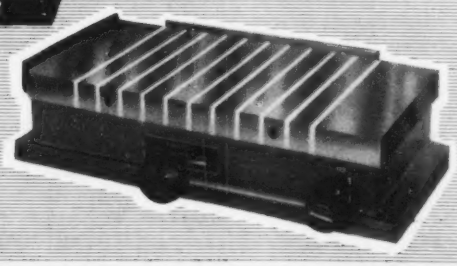

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